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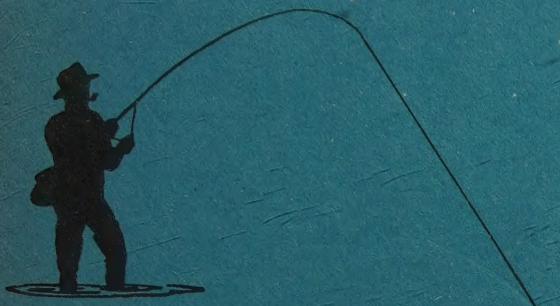

# SPORT FISHERY ABSTRACTS

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DEPARTMENT OF THE INTERIOR
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BUREAU OF SPORT FISHERIES AND WILDLIFE

# DEPARTMENT OF THE INTERIOR

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### U. S. FISH AND WILDLIFE SERVICE

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### BUREAU OF SPORT FISHERIES AND WILDLIFE

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Washington, D. C.

# SPORT FISHERY ABSTRACTS

**An abstracting service for fishery research and management**

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Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

One volume consisting of four numbers is issued each year. Each number contains separate Author and Subject indexes. The final number of each volume contains cumulative Author and Subject indexes and a list of publications screened.

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**9026.** Leim, A.H., and W.B. Scott (Fisheries Research Board of Canada. Biological Station, St. Andrews, N.B., Canada). 1966. FISHES OF THE ATLANTIC COAST OF CANADA. Fisheries Research Board of Canada Bulletin No. 155. 485 p. Pr. $8.50.

This volume attempts the first step in filling the need for an authoritative reference book on the fishes taken off the 21,000 miles of Canadian Atlantic coastline from Grande Manan to Cape Chidley. It contains descriptions of nearly 300 species, including information on size, colouration, range, biology, and economic importance. Most species are illustrated, and numerous Keys are included for identifying individual species. Also included are a glossary of technical terms, over 500 references to pertinent literature, and a comprehensive index.

**9027.** Trent, Lee, and William W. Hassler (Dept. of Zoology, North Carolina State Univ., Raleigh, N.C.). 1966. FEEDING BEHAVIOR OF ADULT STRIPED BASS, Roccus saxatilis, IN RELATION TO STAGES OF SEXUAL MATURITY. Chesapeake Science, 7(4): 189-192.

We determined stomach contents of 1,070 adult striped bass from the Roanoke River, North Carolina, during their upstream migration. Of these, 259 were taken downstream by gill nets in April in the Williamston area, some 93 miles below the major spawning ground. Nearly half (46.3%) of the stomachs contained food, which consisted solely of blueback herring, Alosa aestivalis, or alewife, A. pseudoharengus, or both. All striped bass examined from the downstream station were in a prespawning stage. The remaining 811 specimens came upriver in May from the Weldon area, the major spawning site of striped bass in the Roanoke River. Here, fish caught by hook and line revealed that 4 out of 20 (20.0%) stomachs of females and 10 out of 69 (14.5%) stomachs of males contained food. These fish were in a prespawning or spent stage. Drift nets caught 34 females, which had empty stomachs, and 433 males, of which 11 (2.3%) had food. Of the females, 32 were in a spawning and 2 were in a prespawning stage. Of the males, all but 22 were in a spawning or spent stage. Food items in order of importance were: golden shiner (Notemigonus crysoleucas), unidentified minnows, blueback herring, and gizzard shad (Dorosoma cepedianum). Fight net catches accounted for 29 females and 226 males; all had empty stomachs, and all were in a spawning or spent stage. Thus, we conclude that fasting occurs for only a brief period just before and during the act of spawning. (Authors)

**9028.** Hamer, Paul E. (New Jersey Division of Fish and Game, Nacote Creek Research Station, Absecon, N.J.). 1966. THE OCCURRENCE OF STRIPED CUSK-EEL, Rissola marginata, IN THE BODY CAVITY OF STRIPED BASS, Roccus saxatilis. Chesapeake Science, 7(4): 214-215.

Autopsies of two striped bass, Roccus saxatilis, found dead in two widely separated New Jersey estuaries, revealed a striped cusk-eel, Rissola marginata, in the body cavity of each of them. The body cavity was full of blood. It was tentatively concluded that the coelom was entered through the wall of the alimentary canal, possibly through the bile ducts and liver. Literature is cited which indicates that the cusk eel's tail is an efficient burrowing organ. (Auth.)

**9029.** Nichols, Maynard M., and Robert L. Ellison (Virginia Inst. of Marine Science, Gloucester Point, Va.). 1966. LIGHT-WEIGHT BOTTOM SAMPLERS FOR SHALLOW WATER. Chesapeake Science, 7(4): 215-217.

Two bottom samplers have been developed for rapid operation from a small boat in water depths less than 20 meters. Operation of the Mini-Grab is similar to large conventional grabs. The gravity corer utilizes a plastic tube, which serves as a core barrel. The units are light weight, portable, and quickly assembled. (Authors)

**9030.** Todd, I.S. (Dept. of Fisheries of Canada, Vancouver, B.C., Canada). 1966. A TECHNIQUE FOR THE ENUMERATION OF CHUM SALMON FRY IN THE FRASER RIVER, BRITISH COLUMBIA. The Canadian Fish Culturist, Issue 38, pp. 3-35.

Sampling equipment suitable for capturing seaward migrant Pacific salmon fry in the upper tidal reaches of the Fraser River in British Columbia has been designed and operated by the Department and the International Pacific Salmon Fisheries Commission during the 1961 to 1965 period. Behavioural characteristics of migrant chum salmon fry (Oncorhynchus keta) have been described, and indices of annual abundance have been calculated from the data obtained during the sampling programs. (Auth.)

**9031.** Ruggles, C. P. (Dept. of Fisheries of Canada, Vancouver, B. C., Canada). 1966. DEPTH AND VELOCITY AS A FACTOR IN STREAM REARING AND PRODUCTION OF JUVENILE COHO SALMON. The Canadian Fish Culturist, Issue 38, pp. 37-53.

Coho salmon smolt production was measured in four artificial stream channels 200 feet long by 20 feet wide. Two years' data are presented on the effect of depth and velocity on fish food production, smolt production and fish behaviour. A known number of wild coho fry were introduced to each channel and allowed to take up residence in the channel on a volitional basis. The amount of downstream migration was influenced by the availability of low velocity water. Over twice as many fry remained in a pool-like environment as in a riffle-like condition; an intermediate number remained when the depth-velocity situation was somewhere between pool and riffle. Whereas fish preferred the pool-like environment, fish food production was much higher in the riffle-like environment. The most coho smolt production occurred in a channel composed of one-half riffle and one-half pool. Differences in behaviour were noted between coho fry which had migrated upstream of their place of emergence and fry which had moved downstream from their place of emergence. (Auth.)

**9032.** Marking, Leif L. (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. INVESTIGATIONS IN FISH CONTROL 12. TOXICITY OF MS-222 TO SELECTED FISHES. Bureau of Sport Fisheries and Wildlife Resource Publication 18. p. 1-10.

Toxicity of MS-222 to rainbow trout, brown trout, brook trout, lake trout, northern pike, bluegill, largemouth bass, and walleye of various sizes was determined in 15-, 30-, and 60-minute and 24-, 48-, and 96-hour static bioassays at selected temperatures. Twenty-four-hour $LC_{50}$ values for the eight species ranged from 33.8 to 63.0 ppm. Exposures longer than 24 hours had little effect on toxicity. Small fish of a species were more sensitive to the drug than large ones, and trout were more sensitive at warmer temperatures. Safety indexes were calculated on the basis of the brief exposures. (Auth.)

**9033.** Schoettger, Richard A., and Arnold M. Julin (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. INVESTIGATIONS IN FISH CONTROL 13. EFFICACY OF MS-222 AS AN ANESTHETIC ON FOUR SALMONIDS. Bureau of Sport Fisheries and Wildlife Resource Publication 19. p. 3-15.

MS-222 was tested for its efficacy as an anesthetic for rainbow trout, brown trout, brook trout, and lake trout. Eighty to 135 ppm of MS-222 anesthetized fish within 3 minutes at 7° to 17° C. The fish could be exposed for a total time of 4 to 12 minutes. Fifty to 60 ppm induced a moderate rate of anesthesia which could be maintained for approximately 30 minutes. Sedation was produced within 15 minutes and maintained for 5 to 6 hours at 15 to 30 ppm. The efficacy of sedating concentrations appeared to decrease with time at 17° C. Lake trout required larger doses than the other salmonids for complete anesthesia but tolerated only short exposures. There was no relation between size of fish and efficacy of MS-222. Smaller fish occasionally had shorter exposure times. The drug was equally efficaceous at pH values of 5.0, 7.0, and 8.5. Anesthetic solutions with a total hardness of 10 ppm were less effective in anesthetizing rainbow trout than those containing 35 and 180 ppm. Individuals which were anesthetized in soft water recovered sooner. (Authors)

**9034.** Walker, Charles R., and Richard A. Schoettger (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. INVESTIGATIONS IN FISH CONTROL 14.

METHOD FOR DETERMINING MS-222 RESIDUES IN FISH. Bureau of Sport Fisheries and Wildlife Resource Publication 20. p. 3-10.

MS-222 is a primary aromatic amine. Its diazonium salt reacts with the Bratton-Marshall reagent (N-1-naphthylethylenediamine dihydrochloride) to form a wine-red azo dye with a maximum absorbance at 545 millimicrons. The diazotization reagent had to be modified and the reaction time extended to obtain a measurable yield of the diazonium salt. The regression of absorbance values versus concentrations of MS-222 which ranged from 0 to 7.5 ppm had a slope of 1 and adhered to Beer's law. MS-222 was spiked into samples of blood, muscle, liver, and kidney from rainbow trout, and excellent recoveries were measured by the analytical method. The residues had to be distinguished from a background of primary aromatic amines which varied in each tissue, between individual specimens and with each lot of fish. Backgrounds were higher in liver and kidney, and residues of MS-222 were more difficult to differentiate. The method was particularly effective in determining residues of the drug in muscle and blood of trout. (Authors)

**9035.** Walker, Charles R., and Richard A. Schoettger (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. INVESTIGATIONS IN FISH CONTROL 15. RESIDUES OF MS-222 IN FOUR SALMONIDS FOLLOWING ANESTHESIA. Bureau of Sport Fisheries and Wildlife Resource Publication 21. p. 3-11.

Residues of MS-222 (tricaine methanesulfonate) in the blood, muscle, liver, and kidney of rainbow trout and in the muscle of brown trout, brook trout, and lake trout were measured by a modified Bratton-Marshall colorimetric method. Temperatures were 7°, 12°, and 17° C in waters with total hardnesses of 10 to 180 ppm. The residues were easily detected and measured in blood and muscle, but they were masked in liver and kidney by background substances. The anesthetic dissipated rapidly in the muscle of the four species within 1 to 6 hours, and the residues approached the background levels of controls within 9 to 24 hours after withdrawal from exposure. The differences in residue levels in the muscle at 0-hour withdrawal between species, at three temperatures, and in soft and hard water largely disappeared within 24 hours. (Authors)

**9036.** Schoettger, Richard A. (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. INVESTIGATIONS IN FISH CONTROL 16. ANNOTATED BIBLIOGRAPHY ON MS-222. Bureau of Sport Fisheries and Wildlife Resource Publication 22. p. 3-15.

This bibliography contains 86 selected references on uses of MS-222 on cold-blooded animals including fish and amphibians. Most of the references are annotated. (Auth.)

**9037.** Schoettger, Richard A., Charles R Walker, Leif L. Marking, and Arnold M. Julin (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. INVESTIGATIONS IN FISH CONTROL 17. MS-222 AS AN ANESTHETIC FOR CHANNEL CATFISH: ITS TOXICITY, EFFICACY, AND MUSCLE RESIDUES. Bureau of Sport Fisheries and Wildlife Resource Publication 23. p. 3-14.

MS-222 was tested as an anesthetic on channel catfish. Its acute toxicity is approximately 65 to 50 ppm over periods of 24 to 96 hours. Anesthesia is induced within 2 minutes by concentrations above 100 to 140 ppm, and within 15 minutes by 70 ppm. Concentrations of 20 to 40 ppm maintain sedation for 6 hours. Residues of MS-222 occur in muscles of anesthetized catfish, but decrease about 90 to 95 percent at 1 hour of withdrawal from the drug. Nine to 24 hours after withdrawal the residues decline to within the statistical variations of the background aromatic amines. The influences of duration of exposure, size of fish, temperature, and water quality on toxicity, efficacy, and residues are discussed. (Authors)

**9038.** Fowler, Laurie G., J. Howard McCormick, Jr., and Allan E. Thomas (Bur. of Sport Fisheries and Wildlife, Salmon Cultural Lab., Longview, Wash.). 1966. STUDIES OF CALORIC AND VITAMIN LEVELS OF SALMON DIETS. Bureau of Sport Fisheries and Wildlife Technical Paper 6. p. 3-14.

Feeding trials were conducted with fingerling fall chinook salmon (Oncorhynchus tshawytscha) to determine the effect of an all-meal diet at 4 levels of vitamin supplementation and at 5 caloric levels. Meat supplementation and substitution of soybean oil meal for cottonseed meal in the basal meal ration were tested also. Results after 24 weeks of feeding were as follows: Fish fed an all-meal, vitamin-supplemented diet were successfully maintained throughout the feeding trials; 30-percent meat supplementation resulted in greater deposits of protein but no better protein utilization than comparable all-meal diets; soybean oil meal was an inadequate replacement for cottonseed meal when fed as a component of the basal ration; and addition of supplemental energy calories as peanut oil resulted in a sparing action on the protein requirements of the fish. The diet fed at a level of 2,350 calories per kilogram, with 43 percent of the calories supplied as protein, appeared to be optimum under the conditions of this experiment. Meal-fed fish had no fatty infiltration within the hepatic cells; meat-fed fish had definite abnormal fatty infiltration in the livers. (Authors)

**9039.** Dupree, Harry K. (Bur. of Sport Fisheries and Wildlife, Southeastern Fish Cultural Lab., Marion, Ala.). 1966. VITAMINS ESSENTIAL FOR GROWTH OF CHANNEL CATFISH, Ictalurus punctatus. Bureau of Sport Fisheries and Wildlife Technical Paper 7. p. 3-12.

Symptoms were identified in channel catfish fed diets deficient in the water-soluble vitamins pyridoxine, pantothenic acid, riboflavin, thiamine, folic acid, nicotinic acid, B-12, or choline. Fat-soluble vitamin A and vitamin K deficiency symptoms were observed after feeding diets which contained beta-carotene and 4.0 milligrams of menadione (synthetic vitamin K) per 100 grams of food (dry weight). These deficiencies were eliminated by substituting vitamin A palmitate for beta-carotene and doubling the content of menadione. No dietary need was observed for the water-soluble vitamins biotin, inositol, ascorbic acid, and para-aminobenzoic acid. (Auth.)

**9040.** Elliot, Joseph W., Laurie G. Fowler, and Roger E. Burrows (Bur. of Sport Fisheries and Wildlife, Salmon-Cultural Lab., Longview, Wash.). 1966. EFFECTS OF AGE, GROWTH, AND DIET ON CHARACTERISTICS OF SALMON FINGERLINGS. Bureau of Sport Fisheries and Wildlife Technical Paper 8. p. 3-11.

Body composition, blood chemistry, plasma protein composition, and physical blood properties were measured at monthly intervals for two groups of fall chinook salmon fingerlings (Oncorhynchus tshawytscha). The two lots of fish were fed exclusively either a meat or meal diet. Age, growth, diet, and disease were found to affect one or more of the measured characteristics of these fish. (Authors)

**9041.** Dupree, Harry K., and Kermit E. Sneed (Bur. of Sport Fisheries and Wildlife, Southeastern Fish Cultural Lab., Marion, Ala.). 1966. RESPONSE OF CHANNEL CATFISH FINGERLINGS TO DIFFERENT LEVELS OF MAJOR NUTRIENTS IN PURIFIED DIETS. Bureau of Sport Fisheries and Wildlife Technical Paper 9. p. 3-21.

Weight gains and feed conversions of channel catfish fingerlings fed purified diets that contained casein were superior to those of fingerlings fed diets that contained wheat gluten and soybean proteins. Weight gains were linear with the protein content of the diets, up to approximately 35 percent protein (dry weight basis); greater amounts of protein reduced the weight gain. Weight gains and feed conversions of fish fed diets that contained wheat gluten and soybean protein were greater when fed at water temperature of 76° F than when fed at water temperature of 69° F, while casein was utilized almost equally well at both temperatures. Energy requirement (as reflected in weight gains) is assumed to be greater at 69° F than at 76° F. Corn oil and white dextrin appear to spare protein (as reflected in weight gains) in lower energy diets, but not in higher energy diets. The best feed conversions were obtained with diets that contained 12.5 to 14.0 percent corn oil and 14 to 25 percent white dextrin (dry weight); kilocalories of energy consumed for each kilogram of weight gain were 2,910 and 3,370. Weight gains of fish fed diets that contained 21 percent cellulose flour were superior to weight gains of fish

fed diets that contained 0, 10, 41, and 51 percent cellulose flour (dry weight). The smallest weight gains were obtained with diets that contained 0 and 51 percent cellulose flour. Feed conversion values for the basic purified diet averaged 0.9; feed conversion values for a commonly used meat-pellet hatchery production diet averaged 1.3. No difference was observed either in the total serum protein and hematocrit values of the fish fed either diet or in the serum protein paper chromatograms of these fish and control fish captured in a local river. (Authors)

**9042.** Johnson, Welburne Dewitt, G. Fred Lee, and Demetrios Spyridakis (Water Chemistry Lab., Univ. of Wisconsin, Madison, Wis.). 1966. PERSISTENCE OF TOXAPHENE IN TREATED LAKES. Air & Wat. Pollut. Int. J., 10(8): 555-560.

The persistence of toxaphene (chlorinated camphene) in eight Wisconsin lakes treated for rough fish control has been investigated. Lakes treated with 0.1 ppm of toxaphene 3-9 years prior to sampling had the following distribution of toxaphene: water 1-4 μg/l, sediments 0.2-1 ppm, and aquatic plants 0.05-0.4 ppm. The results suggest that the components of toxaphene are degraded at different rates and that the components have different toxicity for fish. (Authors)

**9043.** Thatcher, Thomas O. (U.S. Dept. of Health, Education, and Welfare, USPHS, R.A. Taft Sanitary Engineering Center, Cincinnati, Ohio). 1966. THE COMPARATIVE LETHAL TOXICITY OF A MIXTURE OF HARD ABS DETERGENT PRODUCTS TO ELEVEN SPECIES OF FISHES. Air & Wat. Pollut. Int. J., 10(9): 585-590.

The lethal toxicity of a mixture of commercial detergent products containing alkyl benzene sulfonate (ABS) to 11 species of fresh-water fishes was determined in flow-through tests. The 96-hour median tolerance limit ($TL_m$) values for these species are compared statistically, and the use of 90 percent (or lower) confidence levels is suggested to allow a margin of safety when using such data to set water quality criteria for protecting aquatic life. Of the species tested, black bullheads, carp, and common shiners are the most resistant to ABS, and these are three times more resistant than the emerald shiners, which are the most sensitive. (Auth.)

**9044.** Dougherty, J.H., C.A. Buescher, Jr., and R.T. Skrinde (Environmental and Sanitary Engineering, Washington Univ., St. Louis, Mo.). 1966. APPLICATION OF ELECTRON AFFINITY ANALYSES TO OXIDATION OF PESTICIDES IN WATER. Air & Wat. Pollut. Int. J., 10(9): 611-625.

The electron affinity detection system as used in this study was successful in qualitatively and quantitatively measuring the electron absorbing compounds, aldrin, dieldrin, and lindane in the nanogram and the picogram range. The system sensitivity is related to the cleanliness of the entire system. Optimization of the system is related to many variables; however, the controlling factor is applied voltage. Reproducible analytical measurements are only possible when operating the system at the optimum voltage. The sensitivity of this detection system permitted the study of the effects of strong oxidants upon trace concentrations of pesticides.

**9045.** Shannon, James E., and G. Fred Lee (Water Chemistry Lab., Univ. of Wisconsin, Madison, Wis.). 1966. HYDROLYSIS OF CONDENSED PHOSPHATES IN NATURAL WATERS. Air & Wat. Pollut. Int. J., 10(10): 735-756.

An investigation was conducted on the rates of hydrolysis of pyrophosphate and tripolyphosphate to orthophosphate under laboratory conditions in various types of natural waters. The rates of hydrolysis of pyrophosphate varied from 0.08 to 0.21 mg P/l per 500 hours at 4° C and from 0.23 to 0.47 mg P/l per 500 hours at 20° C. The rates of hydrolysis of tripolyphosphate varied from 0.07 to 0.22 mg P/l per 500 hours at 4° C and from 0.34 to 0.5 mg P/l per 500 hours at 20° C. Studies on Black Earth Creek located near Madison, Wisconsin, showed the presence of an apparent "natural" condensed phosphate that hydrolysed at approximately the same rate as tripolyphosphate. (Authors)

**9046.** Wellborn, Thomas L., Jr., and Wilmer A. Rogers (Fisheries Laboratory, Agricultural Experiment Station, Auburn Univ., Auburn, Ala.). 1967. FIVE NEW SPECIES OF Gyrodactylus (TREMATODA: MONOGENEA) FROM THE SOUTHEASTERN U.S. Jour. of Parasitology, 53(1): 10-14.

Five new species of Gyrodactylus are described from freshwater fishes of the Southeastern U.S.: G. etheostomae from Etheostoma radiosum (Hubbs and Black), G. hoffmani from Pimephales promelas Rafinesque, G. megacanthus from Fundulus olivaceous (Storer), G. baeacanthus from Notropis venustus (Girard), and G. viriosus from Hypentelium etowanum (Jordan). Gyrodactylus megacanthus is also reported from Fundulus notti (Agassiz) and G. viriosus from Hypentelium nigricans (LeSueur). Fish hosts were collected from Alabama, Arkansas, Georgia, Louisiana, Mississippi, and North Carolina. (Authors)

**9047.** Rogers, Wilmer A. (Agricultural Experiment Station, Auburn Univ., Auburn, Ala.). 1967. NEW GENERA AND SPECIES OF ANCYROCEPHALINAE (TREMATODA: MONOGENEA) FROM CENTRARCHID FISHES OF THE SOUTHEASTERN U.S. Jour. of Parasitology, 53(1): 15-20.

Four new species in two new genera of Ancyrocephalinae are described: Anchoradiscoides serpentinus gen. et sp. n. and Lyrodiscus muricatus gen. et sp. n. from the redear sunfish, Lepomis microlophus (Gunther); Lyrodiscus longibasus sp. n. from the black crappie, Pomoxis nigromaculatus (LeSueur); and Lyrodiscus seminolensis sp. n. from the bluegill, Lepomis macrochirus Raf. Anchoradiscoides most closely resembles Anchoradiscus Mizelle, 1941, by possessing anchors with greatly inflated bases but differs in that the haptoral bars are large and broad and articulate at their ends, rather than V-shaped and articulating in the middle; also, the anchor bases do not occupy the entire haptoral area as in Anchoradiscus. Lyrodiscus appears to be most closely related to Cleidodiscus Mueller, 1934, but differs mainly by the elongate anchors having undifferentiated bases, with anchor points projecting from the lateral edges of the haptor giving it the characteristic lyre-shape, and by the vas deferens looping around an intestinal limb. The fish hosts were collected from Alabama and Georgia. (Auth.)

**9048.** Vincent, Ernest Richard (Zoology and Entomology Dept., Montana State Univ., Bozeman, Mont.). 1967. A COMPARISON OF RIFFLE INSECT POPULATIONS IN THE GIBBON RIVER ABOVE AND BELOW THE GEYSER BASINS, YELLOWSTONE NATIONAL PARK. Limnology and Oceanography, 12(1):18-26.

A study was made of the aquatic insect populations of two riffles, one above and one below the effluents of major geyser basins on the Gibbon River, Yellowstone National Park, from June through September 1963 and from October 1964 through September 1965. Eight 0.25-$m^2$ samples were taken from each riffle on each of the 21 collection dates. Water depths, current speeds, and bottom types were similar in both riffles. Maximum and mean temperatures were greater in the lower riffle. Alkalinity and concentrations of $K^+$, $Na^+$, $Cl^-$, $PO_4^{3-}$, and $SO_4^{2-}$ were markedly greater in the lower riffle. There were 50 taxa in the upper riffle, 45 in the lower. The total number of individuals and biomass was slightly greater in the lower riffle. Ephemeroptera and Coleoptera occurred in greater numbers and biomass in the upper riffle, Trichoptera and Diptera occurred in greater numbers and biomass in the lower, and Plecoptera were about the same for both. Seven of the most numerous organisms in the upper riffle and two in the lower comprised about 68% of the total numbers for each. Ephemeroptera was the dominant order in the upper riffle, and Trichoptera dominated the lower. The thermal and chemical effluents entering the Gibbon River from surrounding geyser basins changed the lower riffle so that it was less diverse, contained a greater standing crop of aquatic insects, and was more favorable to Trichoptera than the upper. (Auth.)

**9049.** Lambou, Victor W., Charles R. Gasaway, Michael G. Bross, and Arvil Ming (Okla. Fishery Research Lab., Norman, Okla.). 1965. OKLAHOMA FISHING WATERS — A PRELIMINARY INVENTORY. Oklahoma Fishery Research Laboratory Bulletin No. 2. 66 p.

**9050.** King, Darrell L., and Robert C. Ball (Dept. of Fisheries and Wildlife, Michigan State Univ., East Lansing, Mich.). 1967. COMPARATIVE ENERGETICS OF A POLLUTED STREAM. Limnology and Oceanography, 12(1): 27-33.

An attempt was made to relate changes in production to variation in stream ecology within a 48.3 km section of a polluted warm-water stream. Energy budgets were constructed for the entire river and for five different ecological zones. The greatest variations were associated with industrial and domestic pollution and the inflow of inorganic sediment from an area of highway construction. Net yield of various aquatic invertebrates was determined from changes in population size between sampling periods. Average net yields for the summer of 1961 were 17 cal $m^{-2}$ $day^{-1}$ for the herbivorous aquatic insects, and 13 cal $m^{-2}$ $day^{-1}$ for the tubificid worms. Photosynthetic efficiency was estimated to be 0.045% of the solar energy available at the surface of the stream. (Authors)

**9051.** Arthur, C.R., and F.H. Rigler (Dept. of Zoology, Univ. of Toronto, Ontario, Canada). 1967. A POSSIBLE SOURCE OF ERROR IN THE $^{14}C$ METHOD OF MEASURING PRIMARY PRODUCTIVITY. Limnology and Oceanography, 12(1): 121-124.

A relationship, not due to self-absorption, has been shown between volume filtered and apparent specific activity of plankton, in which the latter decreases with increasing volume filtered. This decrease is attributed to an increased damage to phytoplankton during vacuum filtration as the volume filtered and consequently the filtration time were increased. Carbon fixation rates calculated from uptake of $^{14}C$ were lower than rates determined by the $O_2$ method (gross fixation) unless they were corrected for loss of $^{14}C$ during filtration. The corrected values were similar to those obtained by the $O_2$ method. (Authors)

**9052.** Cowell, Bruce C. (North Central Reservoir Investigations, Bur. of Sport Fisheries and Wildlife, Yankton, S.D.). 1967. THE COPEPODA AND CLADOCERA OF A MISSOURI RIVER RESERVOIR: A COMPARISON OF SAMPLING IN THE RESERVOIR AND THE DISCHARGE. Limnology and Oceanography, 12(1): 125-136.

An automatic plankton sampler was installed in the powerhouse of Gavins Point Dam to monitor plankton in discharges from Lewis and Clark Lake. These data and samples from the reservoir taken with tow nets indicated that the automatic sampler can be used exclusively to minitor changes in species compositions and densities of Copepoda and Cladocera. The annual discharge of Copepoda and Cladocera from Lewis and Clark Lake was estimated to be 12,619 metric tons, wet weight. Discharges of zooplankton from Lake Francis Case (Ft. Randall Reservoir), 80 km upstream, appear to have considerably more influence upon standing crops in Lewis and Clark Lake than the water exchange rates or the inflow from tributary creeks. (Auth.)

**9053.** Gilderhus, Philip A. (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. EFFECTS OF DIQUAT ON BLUEGILLS AND THEIR FOOD ORGANISMS. Progressive Fish-Culturist, 29(2): 67-74.

Fingerling and adult bluegills (Lepomis macrochirus) were exposed to diquat at various concentrations and frequencies of treatment in outdoor pools for 24 weeks. Residues of the herbicide were measured in the water, bottom soil, and fish. Chronic effects on fish were assessed on the basis of survival, growth, hematological measurements, pathology of different tissues, and the spawning success of adult fish the year after their exposure. Numbers and trends among bottom fauna and plankton were evaluated in relation to the herbicide treatments. Exposed fish did not exhibit any changes or differences which could be attributed to diquat. The herbicide was toxic to cladocera in the pool studies and in controlled laboratory tests. (Auth.)

**9054.** Roberts, Franklin L. (Univ. of Maine, Orono, Me.). 1967. CHROMOSOME CYTOLOGY OF THE OSTEICHTHYES. Progressive Fish-Culturist, 29(2): 75-83.

The current status of fish chromosome cytology is examined, and its potential for future contributions outlined. Developments in methodology are described,

showing that adequate techniques are now available. A compilation of chromosome counts on indigenous North American fishes is included.

**9055.** Morris, A. George (Missouri Dept. of Conservation, Jefferson City, Mo.). 1967. PRODUCTION OF CHANNEL CATFISH TO CREEL SIZE. Progressive Fish-Culturist, 29(2): 84-86.

In the first of 2 successive years, nine 1-acre ponds were stocked with 3,000 channel catfish (Ictalurus punctatus) fingerlings each and fed a floating trout feed. The second year the stocking was 3,000 in 3 ponds, 4,000 in 3 ponds, and 5,000 in 3 ponds. Ponds stocked with 5,000 fish produced more pounds of fish than the ponds at lower rates, and with no increase in mortality. Food conversion was 1.0 at the low stocking rate and 0.93 at the higher. With 145 days of feeding, 2,000 pounds of gain was secured in 1 pond of 5,000 fish. Gain in length and weight was mildly erratic both years, from a low of 7.0 inches (1.3 oz) to 13.5 inches (14.5 oz). Feed cost during one season was 11 cents per pound of gain, and 3.4 cents for each fish fed, with a feed cost of $11 per 100 pounds. (Auth.)

**9056.** Mason, John W., and Robert L. Hunt (Wisconsin Dept. of Conservation, Westfield, Wis.). 1967. MORTALITY RATES OF DEEPLY HOOKED RAINBOW TROUT. Progressive Fish-Culturist, 29(2): 87-91.

Four hundred domestic rainbow trout (Salmo gairdneri) were caught from a hatchery raceway using size 8 worm-baited hooks. Hooks were removed from one lot of 200 and not removed from the second lot of 200. Each trout was anesthetized, fin-clipped, and measured, as were 100 trout comprising a control lot not subjected to hooking. About 66% of the trout released with the hooks survived to the end of the 4-month test. Only 12% of the trout released after hooks were removed survived. No trout in the control lot died. Growth of surviving trout was similar in all 3 lots, averaging about 2 inches per trout. (Authors)

**9057.** Burck, Wayne A. (Fish Commission of Oregon, Elgin, Oreg.). 1967. A METHOD OF SEPARATING COHO SALMON LENGTH-FREQUENCY DISTRIBUTIONS INTO AGE COMPONENTS. Progressive Fish-Culturist, 29(2): 92-97.

This paper presents a flexible method for separating coho salmon (Oncorhynchus kisutch) length-frequency distributions into age components. Length frequencies of known age composition were analyzed, and a close association between the "best" divisional line and the trough interval of the respective length-frequency distributions was found. As proposed, the divisional line is located between the trough interval and the preceding length interval of a length-frequency distribution. Divisional lines located in this position separated correctly by age more than 98% of the fish of known age composition. (Auth.)

**9058.** Steucke, Erwin W., Jr., and Richard A. Schoettger (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. COMPARISON OF THREE METHODS OF SAMPLING TROUT BLOOD FOR MEASUREMENTS OF HEMATOCRIT. Progressive Fish-Culturist, 29(2): 90-101.

Methods of sampling trout blood by puncturing the caudal peduncle or incising the sinus venosus are described. Hematocrits of blood samples collected by those two methods did not differ significantly from hematocrits obtained by excising the caudal fin. Zinc-containing tags affected some fish adversely. Puncturing the caudal peduncle and incising the sinus venosus were apparently harmless. (Authors)

**9059.** Doxtater, Gary (Indiana Dept. of Natural Resources, Indianapolis, Ind.). 1967. EXPERIMENTAL PREDATOR-PREY RELATIONS IN SMALL PONDS. Progressive Fish-Culturist, 29(2): 102-104.

This study was an attempt to rate various predator fishes as to their piscifer-ous abilities in suppressing bluegill (Lepomis macrochirus) populations in small ponds. Northern pike (Esox lucius), chain pickerel (E. niger), grass pickerel (E. americanus), walleye (Stizostedion vitreum), and channel catfish (Ictalurus punctatus) were stocked with bluegills and tested for a 2-year period. Northern pike and channel catfish proved the most promising. (Auth.)

**9060.** Dexter, Ralph W., and D. Bruce McCarraher (Kent State Univ., Kent, Ohio). 1967. CLAM SHRIMPS AS PESTS IN FISH-REARING PONDS. Progressive Fish-Culturist, 29(2): 105-107.

Cyzicus mexicanus is a pest in goldfish rearing ponds in Pennsylvania, and in northern pike rearing ponds in Nebraska. It seriously reduces fish production and increases labor in handling the fish. Preventing the eggs of the shrimp from drying and adding 1 ounce of liquid parathion per 10,000 gallons of pond water are effective measures in controlling the pest. (Authors)

**9061.** Priegel, Gordon R. (Wisconsin Conservation Dept., Oshkosh, Wis.). 1967. IDENTIFICATION OF YOUNG WALLEYES AND SAUGERS IN LAKE WINNEBAGO, WISCONSIN. Progressive Fish-Culturist, 29(2): 108-109.

Young walleyes (Stizostedion vitreum) and saugers (S. canadense), 1 to 3 inches in total length, were distinguished by external examination. The external characteristic used to distinguish between these fishes was the abundance or lack of melanophores on the dorsal surface of the head, especially in the area of the parietal bone. Applied to young walleyes and saugers from Lake Winnebago, Wisconsin, this method gives adequate results in determining success of hatch and abundance when large numbers of fish collected with bait trawls are sampled. (Auth.)

**9062.** Lennon, Robert E., Bernard L. Berger, and Philip A. Gilderhus (Bur. of Sport Fisheries and Wildlife, La Crosse, Wis.). 1967. A POWERED SPREADER FOR ANTIMYCIN. Progressive Fish-Culturist, 29(2): 110-113.

A powered spreader for distribution of sand-formulated antimycin is described. The apparatus is a modified seed spreader and adapted to mounting on the transom of a boat. (Authors)

**9063.** McClain, Alberton L., and Patrick J. Manion (Bur. of Commercial Fisheries, Marquette, Mich.). 1967. AN ALL-SEASON TRAP FOR DOWNSTREAM-MIGRATING FISH AND OTHER AQUATIC ORGANISMS. Progressive Fish-Culturist, 29(2): 114-117.

A trap to capture downstream-migrating animals throughout the year is described. The normal flow of a stream passes through an inclined-plane trap. A system of horizontal screens strains excess water at above-normal flows. An enclosure containing a propane-gas heater, mounted over the inclined screens and catch baskets, permits successful and economical operation during below-freezing weather. The trap captures and retains fish, sea lamprey larvae, and the larger aquatic insects. (Authors)

**9064.** Miller, Lee W., and William F. Perrin (California Dept. of Fish and Game, San Diego, Calif.). 1967. A GILL-NET PLATFORM FOR STUDYING THE DEPTH DISTRIBUTION OF FISHES. Progressive Fish-Culturist, 29(2): 118-120.

The construction of a gill-net platform for use in fish distribution studies is described, and advantages of the apparatus in such work are reported. (Authors)

**9065.** Mason, William T., Jr., J.B. Anderson, and George E. Morrison (Federal Water Pollution Control Administration, Cincinnati, Ohio). 1967. A LIMESTONE-FILLED, ARTIFICIAL SUBSTRATE SAMPLER-FLOAT UNIT FOR COLLECTING MACROINVERTEBRATES IN LARGE STREAMS. Progressive Fish-Culturist, 29(2): 74.

A cylindrical, chromium-plated basket filled with limestone, suspended from a polyurethane-filled metal container, facilitates the collection of a large number and variety of macroinvertebrates from large streams.

**9066.** Allison, Leonard N. (Michigan Conservation Dept., Grayling, Mich.). 1967. BEGGAR-TICKS CAUSE MORTALITY AMONG FINGERLING COHO SALMON. Progressive Fish-Culturist, 29(2): 113.

Achenes of beggar-ticks (Bidens cernuus) were responsible for mortality among coho salmon (Oncorhynchus kisutch) on 2 occasions at the Platte River

Trout Rearing Station in Michigan. In both cases mortality was arrested by dip treatments with 1:15,000 oxalate crystals of malachite green, zinc free, which removed the accompanying fungus. Additional fine screens and deflecting devices were used to help prevent achenes from entering the raceways.

**9067.** Tody, Wayne H. 1966. GREAT LAKES VICTORY. Michigan Conservation, 35(6): 2-8.

Chemical treatment of streams is beginning to control the sea lamprey in Lakes Superior and Michigan. Lamprey numbers in Superior are less than 20 percent of what they were. If they can be cut to 10 percent of former abundance, they will not be a serious threat to fish. Planted lake trout are taking hold in both Superior and Michigan with some spawning in Superior. Coho salmon plants in streams have made good progress. There are plans to introduce chinook salmon to the Great Lakes. Removal of the lake trout and whitefish by the lamprey opened the door for rapid development of the alewife, which are expected to fatten both the coho and chinook. The alewife is now too plentiful but it is hoped that the salmon, lake trout, and rainbow trout will reduce its numbers.

**9068.** Anonymous. 1967. ARE AMERICAN BEACHES IN DANGER, TOO?. U.S. News and World Report, 62(16): 46-47.

The wreck of the oil tanker Torrey Canyon off Britain's southwest coast has given rise to serious concern in the United States. Even a small tanker wrecked on a U.S. coast could devastate nearby resort and fishing areas. The wreck of one the size of the Torrey Canyon would be a regional catastrophe. Detergents or other solvents which would be used in such a case create substances poisonous to aquatic life when mixed with oil. Oysters, crabs and lobsters would be killed. Fish would be killed or tainted. Oil pollution already makes it necessary for some resort owners to supply detergents to help bathers and fishermen remove stains.

**9069.** Lahav, M., S. Sarig, and M. Shilo. 1966. EXPERIMENTS IN THE USE OF BROMEX-50 AS A MEANS OF ERADICATING THE ECTOPARASITES OF CARP. Bamidgeh, 18(3/4): 57-66.

Bromex-50 was examined as a control effective against carp ectoparasites. The maximum concentration which will not harm fingerlings of 1-2 g is 4 ppm, and 7 ppm in respect of those weighing 20-50 g. Dactylogyrus vastator and all species of Gyrodactylus can be effectively controlled with 0.2-0.25 ppm of Bromex-50. D. extensus can be controlled with 0.35 ppm. Argulus attached on fish ponds can be controlled with 0.2 ppm. Argulus which have developed resistance to lindane are as sensitive to Bromex-50 as those which have no resistance to the former preparation. Repeated sprayings of 0.1 ppm of Bromex-50 did not produce any resistance. All the larval stages of Lernaea (copepodides and nauplii) can be controlled with 0.2 ppm of Bromex-50. Concentrations of 0.1 ppm to 1.0 ppm of Bromex-50 did not yield conclusive results with regard to Ichthyophthirius, Costia, Glossatella or Trichodina. (Auth. summ.)

**9070.** Fishelson, L. 1966. CICHLIDAE OF THE GENUS Tilapia IN ISRAEL. Bamidgeh, 18(3/4): 67-80.

The biology and behavior of Israelian species. A possible way of evolution of the mouthbreeding of Tilapia. Results of experimental hybridization.

**9071.** Cauley, Joseph R. (Bur. of Commercial Fisheries Fish-Passage Research Program, Seattle, Wash.). 1966. EFFECT OF WATER VELOCITY ON PASSAGE OF SALMONIDS IN A TRANSPORTATION CHANNEL. U.S. Fish and Wildlife Service, Fishery Bulletin 66(1): 59-63.

Passage times of fish at velocities of 1 and 2 feet per second were compared in a 4-foot wide transportation channel, with a water depth of 6 feet. The timing zone was about 100 feet long. Passage times did not differ significantly between water velocities for any one of three species: chinook salmon (Oncorhynchus tshawytscha), steelhead trout (Salmo gairdneri), and sockeye salmon (Oncorhynchus nerka). The two salmon species moved faster than steelhead trout at both water velocities. (Auth.)

**9072.** Gibbs, Robert H., Jr., and Bruce B. Collette (Div. of Fishes, U.S. National Museum, Washington, D.C.). 1966. COMPARATIVE ANATOMY AND SYSTEMATICS OF THE TUNAS, GENUS Thunnus. U.S. Fish and Wildlife Service, Fishery Bulletin, 66(1): 65-129.

The taxonomic status of the tunas of the world, often placed in the genera Thunnus, Germo, Neothunnus, Parathunnus, and Kishinoella, is assessed through the use of external morphological and internal anatomical characters. Seven species, all included in the single genus Thunnus, are considered valid: T. thynnus, the bluefin tuna; T. alalunga, the albacore; T. obesus, the bigeye tuna; and T. albacares, the yellowfin tuna, are circumglobal in distribution; T. atlanticus, the blackfin tuna, and T. tonggol, the longtail tuna, are restricted to the western Atlantic and the Indo-West Pacific, respectively; T. maccoyii, the southern bluefin tuna, is known in the southern Pacific and Indian oceans and off northwestern Australia. Two subspecies of T. thynnus are recognized: T. t. thynnus in the Atlantic and T. t. orientalis in the Pacific. In Part 1 the comparative anatomy is described and characters are given for differentiating the species by means of counts and measurements and by comparison of the skeletal, visceral, and vascular systems. In Part 2 the genus Thunnus is characterized with respect to other genera of Scombridae, and for each species a synonymy, a resume of distinctive characters, discussion of type specimens and nomenclatural problems, and a review of known geographic distribution are given. (Authors)

**9073.** Major, Richard L., and James L. Mighell (Bur. of Commercial Fisheries Biological Lab., Seattle, Wash.). 1966. INFLUENCE OF ROCKY REACH DAM AND THE TEMPERATURE OF THE OKANOGAN RIVER ON THE UPSTREAM MIGRATION OF SOCKEYE SALMON. U.S. Fish and Wildlife Service, Fishery Bulletin, 66(1): 131-147.

Tagging experiments show that Rocky Reach Dam, constructed on the Columbia River 7 miles above Wenatchee, Wash., in 1957-61, has not appreciably increased the time required for adult sockeye salmon (Oncorhynchus nerka) to migrate to Zosel Dam on the Okanogan River (a tributary to the Columbia River above Rocky Reach Dam). Water temperature of the Okanogan River is, however, a major cause of delay. Above 70° F, rising or stable Okanogan River temperatures block the entry of the fish from the Columbia River into the Okanogan River; falling temperatures allow the migration to resume. Below 70° F, migration is not blocked by rising or stable temperatures. Delay may reduce survival because it increases the exposure of the sockeye salmon to other factors that affect them adversely. (Authors)

**9074.** Marvin, Kenneth T., and Raphael R. Proctor, Jr. (Bur. of Commercial Fisheries Biological Lab., Galveston, Texas). 1966. LABORATORY EVALUATION OF RED-TIDE CONTROL AGENTS. U.S. Fish and Wildlife Service, Fishery Bulletin, 66(1): 163-164.

**9075.** Sears, Mary, and Mary Swallow (Editors). 1967. DEEP-SEA RESEARCH OCEANOGRAPHIC ABSTRACTS AND OCEANOGRAPHIC BIBLIOGRAPHY SECTION. Deep-Sea Research, 14(1): A1-A88.

The first section contains a list of titles and bibliographical references to current papers on oceanography. The list is arranged under the various headings and sub-headings, so that papers dealing with similar subjects will be found in close proximity to one another. The coding used may be subject ot revision in later issues and, as experience dictates, further sub-headings may be added to facilitate reference to papers dealing with the more specific subjects. Another section contains a group of abstracts of current papers on general oceanography and related subjects. Together they will provide a comprehensive service to scientists engaged in deep-sea research and oceanography in general.

**9076.** Chase, Joseph. 1967. OCEANOGRAPHIC OBSERVATIONS, 1964, EAST COAST OF THE UNITED STATES. U.S. Fish and Wildlife Service, Data Report 18, 181 pp. on 3 microfiche.

Daily water temperature and salinity observations for 1964 for 15 locations along the Atlantic seaboard are tabulated, plotted, and discussed.

**9077.** MacInnis, Joseph B. 1966. LIVING UNDER THE SEA. Scientific American, 214(3): 24-33.

To learn more about the ocean and harvest its resources, men must be able to live and work as free divers on the continental shelf. Several research programs are currently developing this ability.

**9078.** Mink, Ken. 1967. BIG TUMBLING CREEK. Outdoor Life, 139(6): 62-65.

For $1 a day licensed anglers can fish and keep five rainbows from a marked-off 4.3-mile stretch of Big Tumbling Creek in southwestern Virginia. An average of 18,000 fishermen use the stream each year. The catch rose from 39,670 trout in 1964, to 46,831 in 1965, to 71,000 in 1966. The trout were from 10 to 22 inches long.

**9079.** Blumer, Max (Woods Hole Oceanographic Inst., Woods Hole, Mass.). 1967. HYDROCARBONS IN DIGESTIVE TRACT AND LIVER OF A BASKING SHARK. Science, 156(3773): 390-391.

The hydrocarbons of zooplankton pass through the digestive tract of the basking shark without fractionation or structural modification. They are resorbed in the spiral valve and deposited in the liver. In contrast to unsaturated fatty acids, the olefinic hydrocarbons are not decreased in concentration. The hydrocarbon assemblage in the digestive tract and in the liver is indicative of the food sources and feeding grounds of the shark. Squalene, abundant in shark liver, occurs only in traces in zooplankton; phytane, if present at all, constitutes less than 0.005 percent of the hydrocarbons of zooplankton and of shark liver. (Auth.)

**9080.** Anonymous. 1967. $300 BILLION FOR CLEAN AIR AND WATER. U.S. News and World Report, 62(14): 42-45.

It is estimated that there will be ten billion dollars a year expended for the next 30 years, of which 4 billion each year will be for control of water pollution. It will mean higher prices, more taxes, closing of some factories, eliminating some coal mining, and tax concessions to help pay industries for control measures. Auto makers plan to spend greatly increased sums which will be paid for, at least in part, by auto buyers. Some production systems currently in use will have to be changed to prevent pollution of air or water. The task of finding means of eliminating and reducing pollution can lead to new research and a whole new industry. One of the first expenses felt by the average citizen will be the $20 to $55 cost of including exhaust controls on all cars built after 1967 — which may add half a billion to the cost of cars purchased next year. Waterborne wastes from steel plants on Lake Michigan are due to stop before 1969, but the companies expect difficulty in meeting the deadline. A Maine paper company spent 4 million dollars rebuilding a plant accused of polluting a river, but it is faced with further expenditures. One of the largest paper corporations on the west coast plans to close some of its mills where "pollution is just too costly to lick". Many small sawmills must merge to economically dispose of sawdust, or sell out their operations.

**9081.** Srinath, E.G., and S.C. Pillai (Dept. of Biochemistry, Indian Inst. of Science, Bangalore, India). 1966. PHOSPHORUS IN SEWAGE, POLLUTED WATERS, SLUDGES, AND EFFLUENTS. The Quarterly Review of Biology, 41(4): 384-407.

Sewage, sludges, and effluents contain appreciable amounts of phosphates, which become a decisive factor in excessive growth of algae and other forms of life when these wastes are discharged into waterways. The presence of phosphates in a body of water indicates its pollution with sewage or other organic wastes. After proper treatment these wastes may be applied to soil and the phosphates thus used to improve crop growth. Much of the readily "available" phosphorus in a fertilizer is quickly "fixed" by the reactive iron and aluminum in soil, and later is released slowly. In waters, however, practically all the soluble phosphorus

entering them becomes immediately available for abundant growth of algae, bacteria, and other forms, resulting in serious problems. When these organisms die and decompose, the oxygen in the water is depleted and offensive changes occur; some organisms produce toxic substances. When sewage and effluents must be discharged into watercourses, phosphorus should be removed from them or reduced to a safe level. The effectiveness of various methods of phosphate removal is examined, and suggestions are made, in the light of accumulating evidence, for obtaining satisfactory results by a combination of biological and chemical methods. (Authors)

**9082.** Stringer, G. E. (Fish and Wildlife Branch, Dept. of Recreation and Conservation, Kilowna, B. C., Canada). 1967. COMPARATIVE HOOKING MORTALITY USING THREE TYPES OF TERMINAL GEAR ON RAINBOW TROUT FROM PENNASK LAKE, BRITISH COLUMBIA. The Canadian Fish Culturist, Issue 39. pp. 17-21.

In order to assess hooking mortality on rainbow trout (Salmo gairdneri), a study was undertaken at Pennask Lake in June 1963 and July 1964 using three types of terminal gear: fly, treble hook, and single hook plus worm behind a spoon or flasher. Flies used were size #8 and #10; the treble hook was size #8 attached directly to a flatfish or spoon; the single hook was size #8 with a short shank connected to a troll by an 8-inch nylon leader. It is concluded that capture and release of rainbow trout in British Columbia is not a serious problem because field observations indicate that most anglers, fishing strictly for sport or fishing after taking their daily limit, are generally using artificial lures, especially flies. Nevertheless, size regulations enacted to protect juvenile or migrant salmonids should be complemented with gear restrictions if bait fishing were prevalent and if an appreciable segment of the population were affected. Moreover, it may be expedient in future to allow catching but not keeping of trout in lakes adjacent to large urban developments, and if this were to happen bait restrictions should be imposed to minimize throwback mortality. Some restrictive regulations suggested by sportsmen favor fly-fishing, but this can be supported only in terms of aesthetic values or personal preference. These data, however, provide no biological basis for discriminating between use of artificial lures such as flies, flatfish, or spoons when angling.

**9083.** Dill, Lawrence M. 1967. STUDIES ON THE EARLY FEEDING OF SOCKEYE SALMON ALEVINS. The Canadian Fish Culturist, Issue 39. pp. 23-34.

A study of migrant sockeye salmon fry (Oncorhynchus nerka) showed that those from an incubation channel (Nanika River, B. C.) weighed 10% less than those from a natural environment (Fifteen-mile Creek, Babine Lake, B. C.), even though both were of the same genetic stock. The possibility of different patterns of early feeding by the fry was explored as the cause of this observed weight difference. Random samples of these migrating fry were taken at intervals. The technique used was to compare the weight gain of the fish (i. e. alevin minus yolk sac) and the weight loss of the yolk over a time interval. Knowing the yolk weight loss and an estimate of the efficiency of conversion of yolk to embryonic tissue, the expected fish weight gain during the interval was calculated. The actual weight gain of the natural fry was significantly larger than the expected weight gain and it is apparent that these fish were utilizing an exogenous food supply prior to complete yolk absorption; this was not true of fish from the incubation channel. A comparison of the two environments indicates that physical factors alone could not have been responsible for the observed weight differences. Feeding by the Fifteen-mile Creek fry is considered to be a direct result of the presence of more food in that situation. The significance of these findings to the subsequent survival of the fry is considered. (Auth.)

**9084.** Smith, M. W. (Fisheries Research Board of Canada Biological Station, St. Andrews, N. B., Canada). 1967. MOVEMENT OF PLANTED HATCHERY-REARED TROUT FROM A NATURAL LAKE. The Canadian Fish Culturist, Issue 39. pp. 35-40.

Extent to which hatchery-reared underyearling and yearling brook and rainbow trout in 21 plantings attempted to leave Crecy Lake, New Brunswick, was determined by year-round operation of a trap on the outlet. A greater proportion of brook than rainbow trout left the lake. Yearlings of both species, particularly those maturing, were most prone to run. Most prominent runs were associated with greatest water discharge from the lake. (Auth.)

**9085.** Smith, M. W. (Fisheries Research Board of Canada Biological Station, St. Andrews, N. B., Canada). 1967. OBSERVATIONS OF FISH-EATING BIRDS AND MAMMALS AT CRECY LAKE, NEW BRUNSWICK, OVER A 12-YEAR PERIOD. The Canadian Fish Culturist, Issue 39. pp. 41-46.

Control of fish-eating birds and mammals was exercised at Crecy Lake, Charlotte County, southwestern New Brunswick, as part of a program to improve angling for brook and rainbow trout, Salvelinus fontinalis (Mitchill) and Salmo gairdneri Richardson (Smith, 1955, 1963). Control was carried out, from March 1952 through October 1963, by a man permanently resident at the lake. Evidence of predation was gained by examining stomachs of killed specimens. The objective of the control measures was obviously to prevent predation by birds and mammals. These observations show that the control was imperfect. However, a much improved survival of planted trout to angler's creels with predator control at Crecy Lake speaks for the effectiveness of the measures.

**9086.** Bullis, Harvey R., Jr., and Rolf Juhl (Bur. of Commercial Fisheries, Exploratory Fishing Base, Pascagoula, Miss.). 1967. PHALANX ORIENTATION IN FEEDING BEHAVIOR OF THE LITTLE TUNA, Euthynnus alletteratus. Trans. American Fisheries Society, 96(2): 122-125.

In September 1964 observations on the feeding behavior of little tuna (Euthynnus alletteratus) were made at Cannouan Island, Lesser Antilles. The observations took place at night during a night-light station in shallow water. Little tuna were observed to form a phalanx-like orientation while apparently feeding on a large aggregation of dwarf herring (Jenkinsia lamprotaenia) directly under the floating night-light. Similar behavior patterns have not been reported on previously. (Authors)

**9087.** Hess, Paul W., and Ruth A. Smith (Dept. of Biology, Lebanon Valley College, Annville, Pa.). 1967. ELECTROPHORESIS OF ELASMOBRANCH SERUM PROTEINS WITH CELLULOSE ACETATE. Trans. American Fisheries Society, 96(2): 131-133.

The blood serum proteins of five species of elasmobranchs were investigated using electrophoresis on cellulose acetate strips. Qualitative and quantitative comparisons of these five shark species with humans, using blood serum protein patterns, have not been reported previously and may contribute to vertebrate comparative hematology. Migration rates and protein patterns were compared with those of human blood serum. Species differences among the five shark species exist in terms of the number of protein components present, their migration rates, and relative amounts. Serum albumins in the sharks were present in very small amounts, compared to human blood serum, and all shark sera contained one protein fraction which moved toward the cathode electrode. (Authors)

**9088.** Cooper, Richard A. (Graduate School of Oceanography, Univ. of Rhode Island, Kingston, R. I.). 1967. AGE AND GROWTH OF THE TAUTOG, Tautoga onitis (Linnaeus), FROM RHODE ISLAND. Trans. American Fisheries Society, 96(2): 134-142.

The validity of age determinations from the opercular bone of the tautog (Tautoga onitis) is established. An examination of the opercular bone margin over a 1-year period demonstrated that the sharp transition from translucent to opaque bone represents a year mark. A logarithmic transformation of both fish length and length of the opercular bone was linear. Lengths at annuli were calculated by this relationship. Males grow faster than females in length (548 mm at age 22 compared with 501), but slower in weight (1,716 grams at age 20 compared with

2,094 grams for females). The eviscerated weight of male and female tautog captured in May and June increased as the 2.78 and 3.02 powers of the length. The greatest age of tautog examined was about 34 years. Growth differences among discrete spawning groups from Narragansett Bay were not significant. (Auth.)

9089. Olla, Bori L., Warren W. Marchioni, and Harvey M. Katz (Bur. of Sport Fisheries and Wildlife, Sandy Hook Marine Lab., Highlands, N.J.). 1967. A LARGE EXPERIMENTAL AQUARIUM SYSTEM FOR MARINE PELAGIC FISHES. Trans. American Fisheries Society, 96(2): 143-150.

An enclosed 32,000-gallon sea-water aquarium with filtration and supply systems and controlled environmental conditions is described. This facility, designed and constructed at the Sandy Hook Marine Laboratory to study the behavior of marine fishes, has been in continuous operation since January 1965. The elliptically-shaped, multiwindowed aquarium may be operated as an open, closed, or semiclosed circulation system. An artificial lighting system developed for the aquarium room provides approximate natural light intensities and duplicates periods of daylight, twilight, and moonlight. (Authors)

9090. Hoss, Donald E. (Bur. of Commercial Fisheries, Radiobiological Lab., Beaufort, N.C.). 1967. MARKING POST-LARVAL PARALICHTHID FLOUNDERS WITH RADIOACTIVE ELEMENTS. Trans. American Fisheries Society, 96(2): 151-156.

The problem of marking post-larval flounder (Paralichthys spp.) with radioisotopes was approached in two ways: (1) by marking with radioactive cerium and cobalt, and (2) by increasing the concentration of stable cobalt in the fish and then making it radioactive through exposure to neutrons in a nuclear reactor (activation analysis). In the first approach, both cerium 144 and cobalt 60, introduced into the food or water, were used satisfactorily as marks for post-larval flounder. The radioactivity obtained from the water was retained longer than that obtained from food. The amount of cerium accumulated by the fish in 24 hours did not increase when the concentration of cerium 144 was raised from 0.4 to 1.0 μc/ml of sea water, but the amount of cobalt 60 accumulated increased when the concentration was raised from 0.01 to 1.0 μc/ml of sea water. In the second approach, fish were marked by holding them for 24 hours in sea water with different concentrations of stable cobalt. Fish held 24 hours in sea water containing 15.62 μg of stable cobalt per ml of sea water and then held for 36 days in flowing sea water contained enough stable cobalt to be identified in the laboratory by activation analysis. (Auth.)

9091. Phinney, Duane E., Denny M. Miller, and Michael L. Dahlberg (Fisheries Research Inst., Univ. of Washington, Seattle, Wash.). 1967. MASS-MARKING YOUNG SALMONIDS WITH FLUORESCENT PIGMENT. Trans. American Fisheries Society, 96(2): 157-162.

Jackson (1959) introduced a technique for mass-marking fish that entails forcing fluorescent pigment into the dermal tissue with compressed air from a small sandblast gun. The technique is faster and less expensive than existing marking methods and is particularly useful in short-term studies of the dynamics and distribution of fish populations. Several experiments were conducted to define the best pigment size and air pressure for marking young salmonids, viz., pink, coho, and sockeye salmon (Oncorhynchus gorbuscha, O. kisutch, and O. nerka) and rainbow trout (Salmo gairdneri), ranging in length from 30 to 120 mm. Two pigment sizes were used: powder, which was less than 20 μ in diameter, and granular pigment, which varied from 30 to 350 μ in diameter. The granular pigment was retained significantly better (55.0-100.0%) than the powder (6.1-89.0%) in test periods ranging up to 130 days. Mark retention among the experimental groups was comparable at air pressures between 80 and 160 psi. Mortality directly attributable to marking was negligible. (Authors)

9092. Kelly, William H. (New York State Conservation Dept., Fish Laboratory, Livingston Manor, N. Y.). 1967. MARKING FRESHWATER AND A MARINE FISH BY INJECTED DYES. Trans. American Fisheries Society, 96(2): 163-175.

A consistent, efficient method for marking brown trout (Salmo trutta) by intracutaneous injection of dyes was developed. Experiments were then conducted with over 150 chemicals in an effort to obtain easily identifiable, long-lasting, weightless, and harmless colored marks. Thirteen dyes in seven colors were durable. The best were National Fast Blue 8GXM, a water-soluble blue dye, and hydrated chromium oxide, an insoluble green pigment. The former most nearly meets the requirements for a satisfactory injection dye. It is non-toxic, retained on all fish for at least two years, and can be applied at a rate of 400 trout per hour. Hydrated chromium oxide was retained on all fish for one year. Encouraging results were also obtained with plastics. In field tests with pond brook trout (Salvelinus fontinalis) these two dyes were retained on all fish after one year with no adverse effects on growth and survival. A four-month test with winter flounders (Pseudopleuronectes americanus) demonstrated mark permanence for the entire period. A new high pressure jet-injection system appears promising. Evidence suggests that depth of injection and growth rate of fish are determinants of mark permanency. Dye fixation in fish skin was not associated with inflammatory cell response. (Auth.)

9093. Houser, Alfred, and James E. Dunn (Bur. of Sport Fisheries and Wildlife, South Central Reservoir Investigations, Fayetteville, Ark.). 1967. ESTIMATING THE SIZE OF THE THREADFIN SHAD POPULATION IN BULL SHOALS RESERVOIR FROM MIDWATER TRAWL CATCHES. Trans. American Fisheries Society, 96(2): 176-184.

Echosounding revealed that large numbers of fish continually inhabit the mid-water zone of 45,440-acre Bull Shoals Reservoir. Fish population sampling in these waters with conventional gear had proved relatively inefficient. In an attempt to develop a method for sampling these waters, a modified and scaled-down version of the "British Columbia" midwater trawl was constructed and operated. Night trawling produced catches composed principally of threadfin shad, Dorosoma petenense (Günther). Fish were found to be vertically stratified in a sharply limited layer between the surface and the thermocline. Concentration was found to decrease with increasing depth but the horizontal distribution was remarkably uniform. The development of a technique for deriving an order of magnitude population estimate is presented. The method employs catch per unit of effort data, the volume of water sampled in a standard haul, depth of strata sampled and volume of water in each stratum. From 72 vertically stratified hauls taken with an 8-foot midwater trawl in the late summer of 1965, a population estimate of 400.8 X $10^6$ young-of-the-year threadfin shad in the reservoir was calculated. (Authors)

9094. Mount, Donald I., and Charles E. Stephan (Fish Toxicology Activities, Fed. Water Pollut. Control Admin., Cincinnati, Ohio). 1967. A METHOD FOR ESTABLISHING ACCEPTABLE TOXICANT LIMITS FOR FISH—MALATHION AND THE BUTOXYETHANOL ESTER OF 2,4-D. Trans. American Fisheries Society, 96(2): 185-193.

Two 10-month exposures of malathion and butoxyethanol ester of 2,4-D under continuous-flow conditions were made to determine the effect of these pesticides on reproduction and growth of fathead minnows, Pimephales promelas Rafinesque. Results show that 1/45 and 1/19 of the 96-hour median tolerance limit ($TL_m$) concentrations of malathion and butoxyethanol ester, respectively, will not harm growth and reproduction of fathead minnows during continuous exposure. We suggest that these two fractions applied to $TL_m$ concentrations determined for other species and other types of water should estimate accurately safe concentrations for other fishes to these pesticides. (Authors)

9095. Harvey, Harold H. (Dept. of Zoology, Univ. of Toronto, Canada). 1967. SUPERSATURATION OF LAKE WATER WITH A PRECAUTION TO HATCHERY USAGE. Trans. American Fisheries Society, 96(2): 194-201.

Water temperature and dissolved oxygen content were measured vertically in Cultus Lake on 20 occasions and dissolved nitrogen eight times during 1961. The results showed the water in the region of the thermocline became supersaturated markedly as a consequence of warming during the spring and summer. The excess gas was below the extent of surface mixing and was held in solution by the hydrostatic pressure. In mid-July at a depth of 30 feet, oxygen was 126% and nitrogen 116% of air saturation. By mid-September at a depth of 50 feet, oxygen saturation was 94% and nitrogen 110% of air saturation. Oxygen was liberated by photosynthesis in the epilimnion and upper portion of the thermocline, and consumed in the lower part of the thermocline and the upper hypolimnion. Thus nitrogen supersaturation could not be diagnosed by measurement of dissolved oxygen alone. Nitrogen supersaturation is discussed in relation to the use of lake water for hatchery culture of fish. (Auth.)

**9096.** Momot, Walter T. (Dept. of Wildlife and Fisheries, Univ. of Michigan and Inst. for Fisheries Research, Mich. Dept. of Conservation, Ann Arbor, Mich.). 1967. EFFECTS OF BROOK TROUT PREDATION ON A CRAYFISH POPULATION. Trans. American Fisheries Society, 96(2): 202-209.

A study was made of the effect of trout predation upon the crayfish population of a marl lake. The study provided a measurement of the efficiency of energy transfer between trophic levels in the lake and the assessment of the relative importance of fish predation as an interspecies interaction. Trout fed only on crayfish less than one year old. Only trout greater than 229 mm in length fed extensively on crayfish. Trout predation accounted for the removal of less than 3% of the population of age-0.0 to 0.5-year crayfish during the period from June to January, and 16% of the population of age-0.5 to 1.0 crayfish from January to May. Crayfish were an important part of the trout diet in midwinter and late summer. Age-0 crayfish which were much larger in midwinter than in summer constituted a greater percentage of the fish diet at these times. On an annual basis trout utilized only 2.9% of the total net production and only 4.2% of the available net production of crayfish biomass in the lake. Substituting the trout predation rate for fishing mortality in Ricker's equilibrium yield equation, showed that a maximum yield of crayfish would be attained at two times the current rate of trout predation. Crayfish yield to the trout might be increased by introducing another smaller crayfish, O. propinquus, with the same reproductive potential as O. virilis. Predation was not an important population control mechanism. (Auth.)

**9097.** Powers, James E., and Anne LaBastille Bowes (Wisconsin Alumni Research Foundation, Madison, Wis.). 1967. ELIMINATION OF FISH IN THE GIANT GREBE REFUGE, LAKE ATITLAN, GUATEMALA, USING THE FISH TOXICANT, ANTIMYCIN. Trans. American Fisheries Society, 96(2): 210-213.

The elimination from the Giant Grebe Refuge, Lake Atitlan, Guatemala, of fish especially largemouth bass (Micropterus salmoides) which is the predator of the rare Giant Pied-billed Grebe chick (Podilymbus gigas), using the new fish toxicant antimycin is described. The toxicant, which was formulated on sand, was added to the Giant Grebe Refuge waters in an amount to give a concentration of 9.3 ppb of antimycin. Within 24 hours large numbers of largemouth bass had succumbed to the effects of the toxicant. Within 10 days the toxicant had degraded to sublethal levels which allowed restocking of the refuge with small fingerlings of Poeciliopsis gracilis and Poecilia sphenops which would serve as diet for the grebes placed in the refuge. (Authors)

**9098.** Priegel, Gordon R. (Research and Planning Div., Wisconsin Conservation Dept., Oshkosh, Wis.). 1967. FOOD OF THE FRESHWATER DRUM, Aplodinotus grunniens, IN LAKE WINNEBAGO, WISCONSIN. Trans. American Fisheries Society, 96(2): 218-220.

**9099.** Horak, Donald L., and William D. Klein (Colorado Game, Fish and Parks Dept., Fish. Res. Center, Ft. Collins, Colo.). 1967. INFLUENCE OF CAPTURE METHODS ON FISHING SUCCESS, STAMINA, AND MORTALITY OF RAINBOW TROUT (Salmo gairdneri) IN COLORADO. Trans. American Fisheries Soc., 96(2): 220-222.

9100. Power, G., and J.R. Colman (Dept. of Biology, Univ. of Waterloo, Waterloo, Ontario, Canada). 1967. WINTER ROTENONING AS A MEANS OF COLLECTING AND STUDYING TROUT IN AN ICE AND SNOW COVERED CANADIAN STREAM. Trans. American Fisheries Society, 96(2): 222-223.

9101. Reed, Roger J. (Univ. of Massachusetts, Coop. Fishery Unit, Dept. of Forestry and Wildlife, Amherst, Mass.). 1967. AGE AND GROWTH OF PRINCE OF WALES, ALASKA, DOLLY VARDEN, Salvelinus malma (Walbaum), AND RAINBOW TROUT, Salmo gairdneri Richardson. Trans. American Fisheries Society, 96(2): 223-224.

9102. Manion, Patrick J. (Bur. of Commercial Fisheries Biological Station, Marquette, Mich.). 1967. DIATOMS AS FOOD OF LARVAL SEA LAMPREYS IN A SMALL TRIBUTARY OF NORTHERN LAKE MICHIGAN. Trans. American Fisheries Society, 96(2): 224-226.

9103. Moe, Martin A., Jr. (Florida Board of Conservation, Marine Laboratory, St. Petersburg, Fla.). 1967. PROLONGED SURVIVAL AND MIGRATION OF THREE TAGGED REEF FISHES IN THE GULF OF MEXICO. Trans. American Fisheries Society, 96(2): 228-229.

9104. Keast, Allen, and Deirdre Webb (Dept. of Biology, Queen's Univ., Kingston, Ontario, Canada). 1966. MOUTH AND BODY FORM RELATIVE TO FEEDING ECOLOGY IN THE FISH FAUNA OF A SMALL LAKE, LAKE OPINICON, ONTARIO. J. Fish. Res. Bd. Canada, 23(12): 1845-1874.

In 14 cohabiting fish species in a small freshwater lake, mouth and body structures combine with food specializations and habitat preferences to greatly restrict interspecific competition within the fauna. The species differ quantitatively in a large number of structures and, individually and in combination, these are clearly adapted for distinctive roles. The mouth is particularly plastic, varying in position, in aperture width, and in overall form, with structures as diverse as a scoop, a beak, and a tube being found. Six basic body types occur and these, combined with varying fin morphologies, result in a range of distinctive forms, including the following. Micropterus salmoides, with a compressed fusiform body and a wide mouth, is a strong-swimming, widely ranging piscivore. Notemigonus crysopterus, with a long, slender caudal peduncle, subfalcate pectoral fins, and a deeply forked caudal fin, has great maneuverability that permits it to catch individual zooplankters. Lepomis macrochirus is a "sedentary," gibbose-bodied water-hanger. Umbra limi has a stubby, cylindrical body that favors life in dense vegetation. Labidesthes sicculus, with an almost straight dorsal line to the body, a low dorsal fin, and a beak-like snout with tweezer-like teeth, is modified for surface feeding and leaping out of the water. Ictalurus nebulosus has chemotactile barbels that favor bottom feeding and paired fins that function partly as hydrofoils, keeping the body inclined downwards as the mouth sweeps the bottom. The structural specializations give their owners a decided ecological advantage in certain situations. Only a few species, however, are limited by them to restricted ways of life. In most cases, a considerable measure of feeding flexibility is retained, presumably important for survival in cold temperate lakes. (Authors)

9105. Sparrow, R.A.H. (Fish and Game Branch, Dept. of Recreation and Conservation, Cranbrook, B.C., Canada). 1966. COMPARATIVE LIMNOLOGY OF LAKES IN THE SOUTHERN ROCKY MOUNTAIN TRENCH, BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 23(12): 1875-1895.

Within a restricted geographical area of British Columbia, detailed examination in 1960 and 1961 of nine lakes having similar morphometric and climate characteristics but exhibiting a wide range in dissolved nutrients (50 to 1463 ppm) suggested that standing crops of plankton were related to oxygen deficits and perimeter-to-area ratios of the lakes. Total dissolved solid contents of the lakes were not closely correlated to standing crops of plankton, bottom fauna, or fish.

Ranking by selected physical or chemical indices of productivity failed to agree with ranking based on standing crops or various biological measurements of productivity. Water level fluctuation, perimeter-to-area ratios, lake basin shape, and the size and nature of the drainage area are discussed as some of the possible factors which interact to modify the expression of the primary factors in productivity. (Auth.)

**9106.** Gerking, Shelby D. (Dept. of Zoology, Indiana Univ., Bloomington, Ind.). 1966. ANNUAL GROWTH CYCLE, GROWTH POTENTIAL, AND GROWTH COMPENSATION IN THE BLUEGILL SUNFISH IN NORTHERN INDIANA LAKES. J. Fish. Res. Bd. Canada, 23(12): 1923-1956.

Eight lake populations of the bluegill sunfish (Lepomis macrochirus) with widely varying growth rates exhibited a surge of growth in the spring followed by a progressively declining growth rate in late summer and autumn. The growth rate declined as age increased; in no case did the growth of an older group exceed that of a younger age group in the same year. Increase in length was estimated from marginal growth of scales collected at various times throughout 1962 and 1963. The beginning of the growing season, assumed to correspond in time with the formation of the annulus, was estimated to average April 8 in 1962 and April 26 in 1963. The time of annulus formation was observed in one lake by collecting scales when the mark was appearing, and in the others it was estimated by extrapolation of a regression between marginal scale growth and time. The end of the growing season, or the time when 90% of the annual growth had been achieved, came on September 10 in 1962 and on September 27 in 1963. The length of the growing season varied among the lakes and between years in the same lake. The range was from 98 to 189 days with an average of 152 days. In one lake the season was a month longer in 1963 than in 1962, but this difference was not evident in the others. The annual rate of growth and the length of the growing season were related. Populations with a rapid growth rate had a longer growing season than those with a slow growth rate. A long season was typified by a somewhat earlier time of annulus formation than a short one and by a considerably longer period of growth in the late summer and autumn. All populations had the same growth potential as judged by weight increment of group III fish during the first month of the season. The first month's increments were 12.6, 12.9, and 13.9 g for populations with rapid, intermediate, and slow annual growth rates respectively. The population with the shortest growing season and the lowest annual growth had the greatest increment during the first month. The strong relationship between size and the time of annulus formation suggested a possible mechanism of growth compensation. Since the smaller fish of a year class begin to grow earlier than do their larger companions, growth compensation may result from the advantage in time gained by the smaller group, assuming that the growing seasons of it and the faster growing members of the cohort end at the same time. Most of the mechanisms offered heretofore have depended upon a difference in the time of hatching between two groups of fish. Consideration is given to an explanation of the annual growth cycle in terms of temperature, photoperiod, and the possible influence of growth hormone at different times of the year. (Auth.)

**9107.** Post, George (Colorado Coop. Fishery Unit, Colorado State Univ., Fort Collins, Colo.). 1966. SERUM PROTEINS AND ANTIBODY PRODUCTION IN RAINBOW TROUT (Salmo gairdneri). J. Fish. Res. Bd. Canada, 23(12): 1957-1963.

Rainbow trout serum was shown to be made up of three major protein components. These three major components did not coincide by electrophoretic mobility or by relative salt solubility with the classic albumin, $\alpha$-, $\beta$-, and $\gamma$-globulin separation of the sera of higher animals. A component equivalent to $\gamma$-globulin of higher animals was found to be completely lacking in the sera of both immunized and non-immunized rainbow trout. Specific humoral antibodies in rainbow trout immune sera were found to be contained in the electrophoretically least mobile proteins. These proteins coincided most nearly to the $\beta$-globulins and possibly the least electrophoretically mobile $\alpha$-globulins of higher animals. Salt solubility

of the serum proteins containing the specific antibody assisted in this conclusion. The electrophoretically least mobile major serum protein components were found to contain all of the antibody activity. These proteins could be removed from immune serum by 20% sodium sulfate. The assumption was made that Aeromonas hydrophila antibodies in immunized rainbow trout blood serum may be made up of a complex of serum proteins with a broad range of salt solubility and electrophoretic mobilities. Serum proteins of rainbow trout could also be classified as euglobulins or pseudoglobulins. The serum proteins which contained the A. hydrophila antibodies were found to be euglobulins. (Auth.)

9108. Katz, Max, James C. Woodey, Clarence D. Becker, P. T. K. Woo, and J. R. Adams (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1966. RECORDS OF Cryptobia salmositica FROM SOCKEYE SALMON FROM THE FRASER RIVER DRAINAGE AND FROM THE STATE OF WASHINGTON. J. Fish. Res. Bd. Canada, 23(12): 1965-1966.

9109. Gibson, R. J. (Dept. of Zoology, Univ. of Western Ontario, London, Ont., Canada). 1966. SOME FACTORS INFLUENCING THE DISTRIBUTIONS OF BROOK TROUT AND YOUNG ATLANTIC SALMON. J. Fish. Res. Bd. Canada, 23(12): 1977-1980.

Juvenile Atlantic salmon and brook trout frequently cohabit the same stream. In the summers of 1963 and 1964, comparisons of habitat preference were made on the two species. Juvenile salmon are found predominantly in riffles and trout in pools. Trout in general remained under overhanging cover, such as alder bushes, or submerged logs or branches except at times of low illumination in the early morning and in the evening. Salmon parr were usually seen away from such cover, feeding in brightly lit open areas of the stream all day.

9110. Saunders, Richard L. (Fisheries Research Board of Canada Biological Station, St. Andrews, N. B., Canada). 1967. SEASONAL PATTERN OF RETURN OF ATLANTIC SALMON IN THE NORTHWEST MIRAMICHI RIVER, NEW BRUNSWICK. J. Fish. Res. Bd. Canada, 24(1): 21-32.

Rates of recapture as grilse of salmon tagged as smolts at two counting fences located 7 and 40 miles above tidehead on the Northwest Miramichi River, New Brunswick, were from 2.5-3.8%. The Northwest Miramichi has early (June-July) and late (September-October) runs of grilse and larger salmon. In this study, returns by and after August 16 are described as early and late respectively. Grilse returns from smolts produced in the headwaters (and tagged at the upper counting fence) were mainly in the early run. Smolts marked at the lower counting fence (but produced in all parts of the river above lower fence) were well represented in both the early and late runs of grilse. Of grilse ascending past the lower counting fence by August 16, a higher percentage of those tagged as smolts at the upper fence than at the lower fence reached the upper part of the river. Of the tagged grilse which ascended past the lower counting fence after August 16, none were recaptured in the upper part of the river. Times of smolt migration to sea and return of grilse appeared to be related to smolt age. Older smolts (age 3 and 4) tended to migrate earlier than younger ones (age 2). Grilse from older smolts were nearly twice as numerous in the early as in the late run; those from younger smolts were nearly equally represented in the early and late runs. (Auth.)

9111. McCrimmon, Hugh R., and U. Boon Swee (Dept. of Zoology, Univ. of Guelph, Guelph, Ontario, Canada). 1967. SCALE FORMATION AS RELATED TO GROWTH AND DEVELOPMENT OF YOUNG CARP, Cyprinus carpio L. J. Fish. Res. Bd. Canada, 24(1): 47-51.

Scales began to form on the body of young carp at 16-18 mm in total length. Scales first appeared anteriorly. The first row formed immediately below the lateral line, except for the posterior four or five scales being typically on the line. Later rows formed in succession above and below the first, each beginning anteriorly. Young carp acquired the typical structure and form of the adult fish by 21 mm. Squamation was completed on fish of 22-26 mm. The development of mouth parts, swim bladder, fins, and body scales appeared to be a function of length. (Authors)

9112. McBride, J.R. (Fisheries Research Board of Canada, Vancouver Laboratory, Vancouver, B.C., Canada). 1967. EFFECTS OF FEEDING ON THE THYROID, KIDNEY, AND PANCREAS IN SEXUALLY RIPENING ADULT SOCKEYE SALMON (Oncorhynchus nerka). J. Fish. Res. Bd. Canada, 24(1): 67-76.

In unfed adult sockeye salmon, Oncorhynchus nerka, histological examination showed extensive degenerative changes in the thyroid, pancreas, and kidney during gonad development. The more pronounced changes were generally noted in starved fish spawned in the wild. Feeding either prevented (thyroid) or distinctly reduced (pancreas, kidney) these changes in the sexually ripe fish. In fed spent sockeye the thyroid showed little change, the kidney exhibited further deterioration although not as marked as in the corresponding unfed fish, but the pancreas showed marked degenerative changes comparable with those exhibited in the unfed. (Auth.)

9113. Coburn, A., and P. McCart (Fisheries Research Board of Canada Biological Station, Nanaimo, B.C., Canada). 1967. A HATCHERY RELEASE TANK FOR PINK SALMON FRY WITH NOTES ON BEHAVIOR OF THE FRY IN THE TANK AND AFTER RELEASE. J. Fish. Res. Bd. Canada, 24(1): 77-85.

A hatchery release tank was designed which permitted the voluntary release of pink salmon (Oncorhynchus gorbuscha) fry. Fry release was stimulated by rising temperatures and increasing turbidity. Because even relatively immature fry left the tank under these conditions, fry were released only between 0800 and 1000 hours, when both temperature and turbidity were low. After entering the stream, hatchery-produced fry appeared to behave normally. They buried themselves during daytime and, within a few days, moved downstream during the night. (Authors)

9114. Coble, Daniel W. (Ontario Dept. of Lands and Forests, Glenora Fisheries Station, Picton, Ont., Canada). 1967. RELATIONSHIP OF TEMPERATURE TO TOTAL ANNUAL GROWTH IN ADULT SMALLMOUTH BASS. J. Fish. Res. Bd. Canada, 24(1): 87-99.

Total yearly growth of smallmouth bass, Micropterus dolomieui Lacépède, of ages 3-5 in South Bay, Lake Huron, and in several other widely scattered populations was related to mean surface water temperature for the period July through September, more growth being associated with warmer waters. No such relationship was demonstrated for bass of the same ages in Lake Opeongo, Ontario, nor for older bass in Lake Opeongo and South Bay. The difference in the manifestation of a growth-temperature relationship appears to be real, rather than a result of differences in data or treatments of them, and indicates, therefore, that other factors may influence total annual growth as much as, or more than, temperature. (Auth.)

9115. McCombie, A.M. (Ontario Dept. of Lands and Forests, Research Branch, Maple, Ont., Canada). 1967. THE THERMAL REGIME OF SOUTH BAY, MANITOULIN ISLAND. J. Fish. Res. Bd. Canada, 24(1): 101-125.

The thermal regime of South Bay is described from records collected from 1953 to 1962 with thermometers, thermographs, and bathythermographs, the last being cast at 11 stations along the bay and one in Lake Huron. Warming begins in April and thermal stratification is established in June. Shallow areas warm more rapidly than deep in the spring and cool more quickly in autumn. The boundary between the epilimnion and the thermocline becomes sharper as summer advances but the transition from thermocline to hypolimnion remains gradual. The average seasonal trend of surface temperatures is a sine function with a maximum of 66° F in mid August and a minimum of 34° F in late March, though values outside this range occur frequently. At 180 feet the maximum of 47° F is attained in November. At the lake and outermost bay stations there is a temperature slump in June and July which may be due to an upwelling in the lake. Evidence of an exchange of water between the lake and bay is seen in vertical temperature sections and water movements. Variations in epilimnial temperatures are correlated with those of the air temperature, but variations in epilimnial and hypolimnial temperatures appear to be unrelated. Finally, literature describing the influence of temperature on the year class strength of smallmouth bass, the distribution of lake trout, the growth of yellow perch, and the life history of Pontoporeia in South Bay is reviewed. (Auth.)

9116. Flux, E. C. (Dept. of Natural History, Univ. of Aberdeen, Aberdeen, Scotland). 1967. FACTORS AFFECTING THE RESPONSE OF TROUT TO AN ELECTRIC FIELD IN FRESH AND SALT WATER. J. Fish. Res. Bd. Canada, 24(1): 191-199.

The "minimum response"-level of Salmo trutta to an alternating current field increased with angle to the field, temperature, resistivity, and fatigue, with a wide range of individual variation. The drop in potential across the length of a fish ("body-voltage") varies directly with length and is not a constant for the species in either fresh or salt water. Embryo trout show a fully developed response 2 weeks after hatching. (Auth.)

9117. Dahlberg, Michael L., and Duane E. Phinney (Fisheries Research Inst., College of Fisheries, Univ. of Washington, Seattle, Wash.). 1967. THE USE OF ADIPOSE FIN PIGMENTATION FOR DISTINGUISHING BETWEEN JUVENILE CHINOOK AND COHO SALMON IN ALASKA. J. Fish. Res. Bd. Canada, 24(1): 209-210.

9118. Tomlinson, N., J.R. McBride, and S.E. Geiger (Fisheries Research Board of Canada, Vancouver Laboratory, Vancouver, B.C., Canada). 1967. THE SODIUM, POTASSIUM, AND WATER CONTENT OF THE FLESH OF SOCKEYE SALMON (Oncorhynchus nerka) IN RELATION TO SEXUAL DEVELOPMENT AND STARVATION. J. Fish. Res. Bd. Canada, 24(2): 243-248.

The influence of feeding on the changes that occur in the skeletal muscle content of sodium, potassium, and water in sockeye salmon (Oncorhynchus nerka) during sexual development and spawning has been investigated. Feeding has little, if any, effect on the changes. Thus it appears that the period of starvation these fish undergo during their spawning migration under natural conditions is not the major cause of the degeneration of their skeletal muscle, but rather that these changes are associated in some manner with the development of the gonads, presumably through the mediation of hormones. (Authors)

9119. Paulik, G.J., and William H. Bayliff (College of Fisheries, Univ. of Washington, Seattle, Wash.). 1967. A GENERALIZED COMPUTER PROGRAM FOR THE RICKER MODEL OF EQUILIBRIUM YIELD PER RECRUITMENT. J. Fish. Res. Bd. Canada, 24(2): 249-259.

The Ricker method for predicting the yield per recruitment from a stock of fish under various conditions is superior to that of Beverton and Holt (1957) under most conditions because it permits greater flexibility of the input of growth and mortality data. Such useful devices as the isopleth diagram and the eumetric fishing curve, usually associated with the Beverton and Holt method, can be used also with the Ricker method. A computer program for the Ricker method is described, and its use is demonstrated with an example. (Authors)

9120. Pycha, Richard L., and George R. King (Bur. of Commercial Fisheries Biological Lab., Ann Arbor, Mich.). 1967. RETURNS OF HATCHERY-REARED LAKE TROUT IN SOUTHERN LAKE SUPERIOR, 1955-62. J. Fish. Res. Bd. Canada, 24(2): 281-298.

Experimental plantings of fin-clipped lake trout (Salvelinus namaycush) of various ages have been made in southern Lake Superior since 1952. The catch of planted lake trout by the commercial fishery was used to measure the success of stocking. Estimates of total returns were based on samples of 8.2 to 21.2% of the Wisconsin catches in 1955-62 and 36.4 to 46.8% of the Michigan catches in 1959-62. Marked lake trout were assigned to various plantings according to the fin mark, length of fish, readings of age from scales, and locations of capture. Estimated returns from Wisconsin plantings of 9-month-old lake trout varied from 2.1 to 6.4%. Wisconsin releases of 16-month-old fish yielded returns of 5.7 to 37.3%. Returns from plantings in Michigan were 0.3% for 9-month-old fish and 1.5 to 3.8% for 16-month-old fish. The ratios of the returns from plantings of 16-month-old fish to those of 9-month-old fish were 3.9:1 for Wisconsin releases and 6.7:1 for Michigan releases. Lake trout planted in Wisconsin generally survived better than

those released in Michigan. Returns from fish planted at ages of 17 to 40 months in Michigan in 1958-59 were far greater than those from 16-month-old fish released in Michigan, but were not as high as from the most successful plantings of 16-month-old fish in Wisconsin. Lake trout released in 1960 from shore and from boats survived equally well. Average size of lake trout at release was more closely related to survival than any other factor. All except 1 of 10 highly successful releases were of fish larger than 22 per pound, and all 6 poor releases were of fish smaller than 34 per pound. Fish that ran 22 to 33 per pound survived only moderately well. A size of 17 to 20 fish per pound appears to be close to optimum. Abundance of native lake trout, American smelt (Osmerus mordax), and sea lamprey (Petromyzon marinus) all appeared to be unrelated to stocking success. The only apparent method of rapidly improving the success of stocking is to rear all lake trout to an average size of 17 to 20 per pound. (Authors)

9121. McCart, P. (Fisheries Research Board of Canada Biological Station, Nanaimo, B.C., Canada). 1967. BEHAVIOUR AND ECOLOGY OF SOCKEYE SALMON FRY IN THE BABINE RIVER. J. Fish. Res. Bd. Canada, 24(2): 375-428.

In the Upper and Lower Babine rivers the fry of sockeye salmon (Oncorhynchus nerka) emerge and move downstream, predominately at night, before reaching low-velocity areas along the stream margins. After a period of days or weeks these fry migrate upstream, close inshore, during the day. The diel pattern of upstream movement appears to be bimodal. The seasonal periodicities of both downstream and upstream movement are related to water temperatures. Upstream migrants were larger than downstream migrants in the Upper Babine River but not in the Lower Babine River. Upper River upstream migrants were similar in length to Lower River upstream migrants during 1964 but not in 1965. In both years Upper River fry weighed proportionately more than Lower River fry, and in both rivers 1964 fry weighed proportionately less than 1965 fry. Some possible explanations of these observations are discussed. Early in the season, fry tend to disperse alongshore after entering the lake. Later they leave these inshore areas and become entirely pelagic. The principal foods of fry both in the river and in the lake were copepod and cladoceran plankters. Both fish and birds were found to be preying on sockeye salmon fry. Fry appear to be more vulnerable to predation in the river than in the lake. The upstream movement of fry in the Babine River does not appear to differ appreciably from upstream movements in other areas. A comparison of fry movements in the Babine River and the Fulton River, where fry move only downstream, suggests that the differences in behaviour are genetically rather than environmentally induced. It is suggested that, because of high mortalities in the prepelagic period, upstream-migrant populations will only develop where the environment of both the river and the rearing lake are especially favourable. (Auth.)

9122. Stringer, G.E. (Dept. of Recreation and Conservation, Fish and Wildlife Branch, Kelowna, B.C., Canada). 1967. INTRODUCTION OF Mysis relicta Lovén INTO KALAMALKA AND PINAUS LAKES, BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 24(2): 463-465.

9123. Stewart, Nelson E., Dean L. Shumway, and Peter Doudoroff (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oreg.). 1967. INFLUENCE OF OXYGEN CONCENTRATION ON THE GROWTH OF JUVENILE LARGEMOUTH BASS. J. Fish. Res. Bd. Canada, 24(3): 475-494.

Experiments are reported on the influence of nearly constant dissolved oxygen concentrations, both below and above the air-saturation level, and of wide diurnal fluctuations of oxygen concentration on the appetite, growth, and food conversion efficiency of juvenile largemouth bass, Micropterus salmoides (Lacépède). The experimental apparatus used was designed to provide constant flows of water at 26° C and with controlled oxygen content through 12-gallon (45-liter) bottles each containing 10 test fish. The fish were fed unrestricted rations of small, live earthworms throughout the six experiments, whose duration was usually 15 days. The growth rates and food consumption rates of the bass increased markedly with

increase of the constant oxygen concentrations to levels near the air-saturation level, and declined with further increase of oxygen concentrations. Gross food conversion efficiencies were considerably reduced only at concentrations well below 4 mg/liter. The growth of bass subjected alternately to low and higher oxygen concentrations for either equal or unequal portions of each 24-hour day was markedly impaired. It was almost always less than that which presumably would have occurred had the fish been held at a constant concentration equal to the mean, either arithmetic or geometric, of the higher and lower concentrations to which the fish had been exposed. (Authors)

9124. Clark, Francis W., and Miles H. A. Keenleyside (Dept. of Zoology, Univ. of Western Ontario, London, Ont., Canada). 1967. REPRODUCTIVE ISOLATION BETWEEN THE SUNFISH Lepomis gibbosus AND L. macrochirus. J. Fish. Res. Bd. Canada, 24(3): 495-514.

Reproductive isolation appeared to be complete between pumpkinseed (Lepomis gibbosus) and bluegills (L. macrochirus) when equal numbers (1:1 sex ratio) were stocked in each of two similar ponds near London, Ontario, and observed during the breeding seasons of 1964 and 1965. Ethological isolation, through visual recognition of potential conspecific mates, was probably the major barrier to hybridization. Interspecific courtship and attempted spawning were not seen; intraspecific courtship and spawning were frequently observed. No clearly identifiable hybrids were found among large numbers of yearling and 2-year-old offspring collected in both ponds in 1965 and 1966. Pumpkinseeds began nesting about 3 weeks before bluegills, but spawning by the two species broadly overlapped in time both years. Individual pumpkinseeds occupied nests for an average of 18.5 days; bluegills for 8.7 days. Duration of pumpkinseed nest occupancy appeared to vary directly with surface water temperature, whether eggs or fry were in the nests or not, whereas bluegills tended to remain on nests containing eggs or fry, regardless of temperature fluctuations. Bluegills nested in deeper water and further from shore than pumpkinseeds, and bluegills tended to nest in colonies whereas pumpkinseeds did not. Interspecific differences were not found in nest site selection with respect to substrate or vegetation. (Authors)

9125. Doyle, J. (Marine Station, Millport, Isle of Cumbrae, Scotland). 1967. THE 'LORENZAN SULPHATES'. A NEW GROUP OF VERTEBRATE MUCOPOLYSACCHARIDES. Biochem. J. 103(2): 325-330.

The mucopolysaccharide from the glands of Lorenzini of Squalus acanthias has been isolated and purified. The material is a sulphated polysaccharide containing glucosamine, galactosamine, galactose and traces of an uronic acid. This vertebrate polysaccharide is unusual in appearing to have both amino sugars present in the molecule. The amino sugars are N-acetylated. This molecule is one of a group of related mucopolysaccharides which vary in composition with the animal species. The generic name 'lorenzan sulphates' is suggested to describe these substances. (Auth.)

9126. Edmund, Norman W. (Edmund Scientific Co., Box 500, Edscorp Bldg., Barrington, N.J.). 1967. OLD TIRES: THE IDEAL MATERIAL FOR BUILDING FISH HAVENS. Edmund Scientific Co., Barrington, N.J. 16 p. Single copy . 10¢

9127. Woodwell, George M., Charles F. Wurster, Jr., and Peter A. Isaacson (Biology Dept., Brookhaven Natl. Lab., Upton, New York). 1967. DDT RESIDUES IN AN EAST COAST ESTUARY: A CASE OF BIOLOGICAL CONCENTRATION OF A PERSISTENT INSECTICIDE. Science, 156(3776): 821-824.

DDT residues in the soil of an extensive salt marsh on the south shore of Long Island averaged more than 13 pounds per acre (15 kilograms per hectare); the maximum was 32 pounds per acre (36 kilograms per hectare). A systematic sampling of various organisms from the vicinity showed concentrations of DDT increasing with trophic level through more than three orders of magnitude from 0.04 ppm in plankton to 75 ppm in a ringbilled gull. Highese concentrations occurred in scavenging and carnivorous fish and birds, although birds had 10 to 100 times

more than fish. These concentrations approach those in animals dying from DDT poisoning, which suggests that many natural populations in this area are now being affected, possibly limited, by DDT residues. Similar concentrations have been reported elsewhere in North America. (Authors)

9128. Hoese, H. Dickson, and Doug Hoese (Inst. of Marine Science, Univ. of Texas, Port Aransas, Texas). 1967. STUDIES ON THE BIOLOGY OF THE FEEDING REACTION IN Gobiosoma bosci. Tulane Studies in Zoology, 14(2): 55-62.

In the naked goby, Gobiosoma bosci, an inhabitant of oyster reefs, a feeding reaction was induced with dialyzed oyster extracts. Certain amino acids and amines with similar molecular structure also induced feeding. Basically they have straight chains, 2-5 carbon atoms, and no group interfering with the area of the nitrogen atom. Dialyzed and chromatographed oyster extracts were bitten by gobies in areas corresponding with knowns of alanine, aspartic acid, glutamic acid, glycine, and an unknown. The unknown, which was heat stable, received most of the response with alanine next. Gobies responded to water in which oysters had been held and to water from an oyster reef, but not to sea water. Feeding by Gobiosoma bosci is divided into two phases. The first seems to be following a volatile compound, possibly an amine, to the oyster. Feeding itself is induced by a heat-stable unknown, with lesser contribution by certain amino acids. (Authors)

9129. Summerfelt, Robert C., William M. Lewis, and M. Gene Ulrich (Dept. of Zoology, Kansas State Univ., Manhattan, Kansas). 1967. CHANGES IN CERTAIN BLOOD COMPONENTS OF GOLDFISH MAINTAINED IN SEALED CONTAINERS. Progressive Fish-Culturist, 29(1): 3-12.

Mortality of goldfish (Carassius auratus) in sealed containers was most closely associated with increments in metabolically produced carbon dioxide and generally began when the carbon dioxide concentration exceeded 200 ppm. Physiological changes in these goldfish included significant alterations in the concentration of circulating erythrocytes, oxyhemoglobin, and coagulation time. Initial increase occurred in oxyhemoglobin and hematocrits at densities of 3.5 and 4.0 lb per gallon and at intervals of 24 to 48 hours. At densities of 5.0 to 7.0 lb per gallon, when fish were held for intervals of 72 to 120 hours, the oxyhemoglobin concentration and the hematocrit value declined. A sharp decline in these variables was generally associated with a sharp decline in the survival curve. Mortality of goldfish maintained in sealed containers with an atmosphere of oxygen also was associated with intra-abdominal hemorrhaging, loss of serum protein, a sharp increase in coagulation time, and a slight increment in erythrocyte fragility. (Authors)

9130. Summerfelt, Robert C., William M. Lewis, and M. Gene Ulrich (Dept. of Zoology, Kansas State Univ., Manhattan, Kansas). 1967. MEASUREMENT OF SOME HEMATOLOGICAL CHARACTERISTICS OF THE GOLDFISH. Progressive Fish-Culturist, 29(1): 13-20.

Analyses of the blood components of 140 goldfish (Carassius auratus) involving 590 separate determinations, yielded data which will help to establish standards for oxyhemoglobin, hematocrit, erythrocyte fragility, serum protein concentration and coagulation time for goldfish. Statistically significant differences ($P > .01$) were found in mean hematocrits and oxyhemoglobin values between male and female goldfish. A significant positive correlation between oxyhemoglobin and hematocrit values was found. Hematocrit values were used to estimate oxyhemoglobin values with an accuracy of between 3.6 and 6.6% for male and female goldfish. Comparison of values for the various variables for the goldfish with those published for other fishes indicated considerable interspecific differences for some of the variables. (Authors)

9131. Johnson, M. G. (Metropolitan Toronto and Region Conservation Authority, Toronto, Ont., Canada). 1967. SUMMER TEMPERATURE RELATIONS IN STREAM-FED PONDS IN SOUTHERN ONTARIO. Progressive Fish-Culturist, 29(1): 21-26.

The temperature characteristics of 31 stream-fed trout ponds were examined during a prolonged period of exceptionally warm weather. Brook trout (Salvelinus fontinalis) survived in all ponds with a deep-water temperature below 70° F. Trout were successful in all ponds with turnover periods (volume of pond divided by volume of inflow per day) of 16 days and less. Predicting equations were developed which relate the turnover period and temperature of the inflow to ambient surface, average, and deep-water temperatures of the ponds. The useful role of Chara in preserving temperatures suitable for trout was noted. (Auth.)

9132. Childers, William F., and George W. Bennett (Illinois Natural History Survey, Urbana, Ill.). 1967. HOOK-AND-LINE PRODUCTION OF LARGEMOUTH BASS AND REDEAR X GREEN SUNFISH HYBRIDS IN A ONE-ACRE POND. Progressive Fish-Culturist, 29(1): 27-35.

The hook-and-line yield of redear (Lepomis microlophus) x green sunfish (L. cyanellus) hybrids and largemouth bass (Micropterus salmoides) from a fertilized 1-acre pond was studied for 6 years (1960-65, inclusive). In 1962, the yield was 417 lb per acre under a fishing pressure of 312.5 man-hours per acre (the highest hook-and-line yield of fish recorded for any water in Illinois), and the average rate of catch was 6.2 fish per man-hour (the highest rate recorded for any Illinois water from which a complete creel record was available). Although redear x green sunfish hybrids were capable of producing an $F_2$ generation, few of the second-generation of fish were able to survive bass predation; 2 seasons after the year the maximum yield was made, only 71 hybrids were caught. At the end of the 1965 fishing season the pond contained only 29 redear x green sunfish hybrids (average weight, 0.7 lb) and 776 bass (of which 404 were young-of-the-year). During the 6 years, bass yields were exceptionally high. (Authors)

9133. Mulla, Mir S., James St. Amant, and Lauren D. Anderson (Univ. of California, Riverside, Calif.). 1967. EVALUATION OF ORGANIC PESTICIDES FOR POSSIBLE USE AS FISH TOXICANTS. Progressive Fish-Culturist, 29(1): 36-42.

Chemicals used in programs for mosquito and chironomid midge control were evaluated for effects on carp (Cyprinus carpio) held in fiberglass tanks, plastic tubs, and a semifield pond. Largemouth bass (Micropterus salmoides) were included in the pond tests. (Authors)

9134. Helms, Don R. (Iowa State Conservation Comm., Des Moines, Iowa). 1967. USE OF FORMALIN FOR SELECTIVE CONTROL OF TADPOLES IN THE PRESENCE OF FISHES. Progressive Fish-Culturist, 29(1): 43-47.

To determine whether tadpoles could be selectively controlled in fish hatchery ponds, toxicity of formalin to tadpoles and selected fishes was evaluated under laboratory and field conditions. The minimum lethal dose for the tadpole of the leopard frog was found to be 30 ppm, while the same value for larger (4-inch) tadpoles of the bullfrog was 80 ppm. Smaller tadpoles of the bullfrog were more sensitive, and it was postulated that those less than 1 inch in length could be controlled at 30 ppm. Fishes tolerated 45 ppm or more. Oxygen depletion tests indicated that ponds could be treated with as much as 30 ppm formalin without causing serious oxygen depletion if the water temperature was not above 65° F. Since this concentration is within the tolerance limits of all 5 species tested, leopard frog tadpoles can be selectively controlled by applying 30 ppm formalin to ponds. Larger tadpoles of the bullfrog cannot be selectively controlled, but the very young ones will probably be sensitive enough to make selective control possible. The oxygen depletion associated with the use of formalin in ponds was attributed to a chemical reaction between the dissolved oxygen in the pond water and the formaldehyde. (Auth.)

9135. Lahser, Carl W., Jr. (Sinton, Texas). 1967. Tilapia mossambica AS A FISH FOR AQUATIC WEED CONTROL. Progressive Fish-Culturist, 29(1): 48-50.

The potential of Tilapia mossambica Peters as an aquatic weed control agent was determined through a series of feeding experiments. This fish was offered various aquatic pest plants. Results indicate that control of a number of plant species typical of ponds and slow-moving water might be obtained with this fish. (Auth.)

**9136.** Viox, Charles A., Jr. (Wyoming Game and Fish Dept., Lander, Wyo.). 1967. BISEXUAL CUTTHROAT TROUT. Progressive Fish-Culturist, 29(1): 51-52.

Numerous occurrences of hermaphroditism were found in cutthroat trout (Salmo clarki) during spawning operations in Newton Lake, Park County, Wyoming. Approximately 50% of the fish examined showed bisexual development. It was difficult to obtain enough milt for effective fertilization of the eggs, and egg losses ranged from 28% to 48%. Studies are being made to determine whether the condition is hereditary or caused by the chemical composition of this water. (Auth.)

**9137.** Rabe, Fred W. (Univ. of Idaho, Moscow, Idaho). 1967. THE TRANSPLANTATION OF BROOK TROUT IN AN ALPINE LAKE. Progressive Fish-Culturist, 29(1): 53-55.

Brook trout (Salvelinus fontinalis) from a small overstocked high lake were transplanted into a nearby lake similar in size but almost completely devoid of fish. Seven weeks later, the transplanted trout showed mean increases of 2.1 inches and 6.2 ounces, but fish from the control lake showed little change in length or weight. Thirteen months after the original transplantation, the transplanted trout showed a net increase of 5.8 inches and 15 ounces over the control fish. Sizes and patterns of fish scales are compared, and some management considerations involved in this type of stocking are discussed. (Auth.)

**9138.** Durkin, Joseph T., and Donn L. Park (Bur. of Commercial Fisheries, Fish-Passage Research Program, Seattle, Wash.). 1967. A PURSE SEINE FOR SAMPLING JUVENILE SALMONIDS. Progressive Fish-Culturist, 29(1): 56-59.

Specialized purse seine equipment was developed to collect live fingerling salmonids in the limnetic zone of Brownlee Reservoir on the Snake River. Construction details of the seine and related equipment are described. Mobile gear included a raft, with a winch and "A" frame, and a skiff. A special depressor weight was used to maintain tight closure of the wing and bunt ends of the seine during pursing. Operated by a four-man crew, the unit effectively captured salmonids as short as 50 mm. (Authors)

**9139.** McCleave, J. D., L. A. Jahn, and C. J. D. Brown (Montana State Univ., Bozeman, Mont.). 1967. MINIATURE ALLIGATOR CLIPS AS FISH TAGS. Progressive Fish-Culturist, 29(1): 60-61.

Cadmium-plated steel alligator clips, 28 mm by 5 mm, were used successfully as short-term tags for cutthroat trout (Salmo clarki). The clips were color-coded with spray enamel and attached to the posterior edge of the dorsal fin at its base. The clips were also used to attach styrofoam floats and miniature ultrasonic transmitters to cutthroat trout. (Authors)

**9140.** Winther, John K. (Univ. of Michigan, Ann Arbor, Mich.). 1967. MEASURING BOARD FOR SMALL FISHES. Progressive Fish-Culturist, 29(1): 62-63.

A measuring board consisting of ordinary graph paper and a wooden base has been used successfully for taking length data from large samples of small fishes under both laboratory and field conditions. Length data obtained by three methods--the measuring board, dividers, and vernier calipers--are compared, showing no difference in accuracy at the 5% level of significance. (Auth.)

**9141.** Perry, Wesley Guthrie, Jr. (Louisiana Wildlife and Fisheries Comm., Alexandria, La.). 1967. AN IMPROVED METHOD OF SECTIONING CATFISH SPINES FOR AGE AND GROWTH STUDIES. Progressive Fish-Culturist, 29(1): 12.

Histological sectioning has been found to be effective in age and growth determinations of catfish. (Auth.)

**9142.** Nagata, Thomas H. (Alaska Dept. of Fish and Game, Juneau, Alaska). 1967. ARTIFICIAL SPAWNING OF ANADROMOUS DOLLY VARDEN. Progressive Fish-Culturist, 29(1): 26.

The Alaska Department of Fish and Game located a stream system that had large numbers of anadromous Dolly Varden (Salvelinus malma) available for

artificial spawning. The Dolly Varden were captured with a bag seine, held in pens until ripe, and spawned by the dry method. Sixty-eight females were artificially spawned; approximately 200,000 eggs were obtained. Problems encountered are discussed, and recommendations included. (Auth.)

9143. Zimmer, Paul D. (Bur. of Commercial Fisheries, Portland, Oreg.). 1967. A NOTE ABOUT SQUAWFISH. Progressive Fish-Culturist, 29(1): 35.

Data on growth and movement of tagged northern squawfish (Ptychocheilus oregonensis) of the Columbia River.

9144. Busbee, Raymond L. (Univ. of Georgia, Athens, Ga.). 1967. AN AID IN HAND-PICKING BENTHIC ORGANISMS. Progressive Fish-Culturist, 29(1): 61.

Light Green SF Yellowish Histological and Cytological Stain is added to benthic organism samples at the time of collection in the field. The samples are returned to the laboratory and thoroughly washed to remove all traces of the stain, and the organisms are then removed with forceps. The dye penetrates the bodies of the organisms, making them much less difficult to detect and remove from the sample. (Auth.)

9145. Mawdesley-Thomas, Lionel E., and John S. Leahy (Huntingdon Research Centre, Huntingdon, England). 1967. ORGANOCHLORINE PESTICIDE RESIDUES IN PIKE. Progressive Fish-Culturist, 29(1): 64.

Examination of tissue extracts and chromatograms of 2 size groups of pike (Esox lucius) showed higher concentrations of organochlorine pesticides in the larger fish.

9146. Suttkus, Royal D., and John S. Ramsey (Dept. of Biology, Tulane Univ., New Orleans, La.). 1967. Percina aurolineata, A NEW PERCID FISH FROM THE ALABAMA RIVER SYSTEM AND A DISCUSSION OF ECOLOGY, DISTRIBUTION, AND HYBRIDIZATION OF DARTERS OF THE SUBGENUS Hadropterus. Tulane Studies in Zoology, 13(4): 129-145.

A new species of Percina (subgenus Hadropterus) from the Alabama River system is described and compared with nigrofasciata, sciera and lenticula. The new species P. aurolineata is closest to P. sciera, but differs in average number of lateral-line scales and vertebrae and in color pattern. Samples for comparison of the species of the subgenus were obtained from co-inhabiting populations. Range extensions are given for Percina lenticula and P. sciera. Hybridization between P. nigrofasciata and P. sciera is described and discussed. (Authors)

9147. Owen, R. W., Jr. (Bur. of Commercial Fisheries Tuna Resources Lab., La Jolla, Calif.). 1967. ATLAS OF JULY OCEANOGRAPHIC CONDITIONS IN THE NORTHEAST PACIFIC OCEAN, 1961-64. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 549. 85 p.

An atlas of July oceanographic conditions in 1961-64 is presented for the region bounded by the coast of Oregon-Washington and long. 132° W. The atlas consists of charts that show distributions of temperature, salinity, density, oxygen concentration, thickness of mixed layer, dynamic height, chlorophyll a concentratio and catch of albacore, Thunnus alalunga (Bonnaterre), at the time of year when albacore first become available to the commercial fishery of the region. Some remarks on the albacore catch and the environment are included. (Auth.)

9148. Rounsefell, George A., and Walter R. Nelson (Univ. of Alabama, University Ala.). 1966. RED-TIDE RESEARCH SUMMARIZED TO 1964 INCLUDING AN ANNOTATED BIBLIOGRAPHY. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 535. 85 p.

This paper summarizes from published and unpublished data and reports the status of research on the Florida red-tide up to 1964. It contains 292 references, mostly annotated, on red-tide and closely related subjects. The relation of oceanographic conditions to red-tide blooms, the seasonal and coastwise distribution of the Florida red-tide, and progress in various aspects of research are discussed. (Authors)

9149. Wilson, Peter C., and Martin R. Bartlett (Bur. of Commercial Fisheries Exploratory Fishing and Gear Research Base, Gloucester, Mass.). 1967. INVENTORY OF U.S. EXPLORATORY LONGLINE FISHING EFFORT AND CATCH RATES FOR TUNAS AND SWORDFISH IN THE NORTHWESTERN ATLANTIC, 1957-65. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 543. 52 p.

This report summarizes the results of longline explorations for tunas and swordfish by the Bureau of Commercial Fisheries and the Woods Hole Oceanographic Institution in the Northwestern Atlantic from March 1957 to June 1965. Fishing log data from 31 exploratory cruises are summarized in 12 monthly tables that give the date, time, position, number of hooks fished and catch for each longline set. The total and monthly fishing effort (number of longline sets and hooks fished within each 1° latitude and longitude square) is shown by 13 figures. Similar figures show the total and monthly average and maximum number of bluefin, yellowfin, albacore, and bigeye tunas, and swordfish caught per 100 hooks within each 1° square. Two figures show the monthly catch rates for blackfin and skipjack tunas by 1° squares. (Authors)

9150. Dragovich, Alexander, and John A. Kelly, Jr. (Bur. of Commercial Fisheries Biological Lab., St. Petersburg Beach, Fla.). 1966. DISTRIBUTION AND OCCURRENCE OF Gymnodinium breve ON THE WEST COAST OF FLORIDA, 1964-65. U.S. Fish and Wildlife Service Special Scientific Report--Fisheries No. 541. 15 p.

The distribution and monthly occurrence of Gymnodinium breve, the Florida red-tide organism, were determined over a period of 13 months (in 1964-65) in the coastal waters of west Florida. Counts of G. breve varied from 0 to 53,800 cells per liter of water; no fish kills were observed. The organism was present at all stations from 9.3 km (5 miles) to 37.1 km (20 miles) offshore. It was not present at all in samples from Tampa Bay, and it was found only twice in samples from Charlotte Harbor. The highest occurrence of G. breve was in samples taken 27.8 km (15 miles) offshore. Vertical distribution of the species was greatest at the surface and at 5 m and lowest at 20 m. The largest concentrations of G. breve occurred in September during a period of reduced salinity and temperature. Because these two factors are important to the ecology of the organism, their relation to the presence or absence of G. breve is discussed. G. breve were found within the temperature range 13.8° to 30.6° C. It was absent or rare at both the low and high temperatures; cell densities greater than 1,000 per liter were observed from 26.0° to 27.9° C. The organism occurred at salinities ranging from 33.68 to 37.07 °/oo. The highest concentration of cells and incidence was noted within the salinity range 35.00 to 36.90 °/oo. (Authors)

9151. Anderson, William D. (Bur. of Commercial Fisheries Biological Lab., Brunswick, Ga.). 1967. FIELD GUIDE TO THE SNAPPERS (LUTJANIDAE) OF THE WESTERN ATLANTIC. U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries Circular 252. 14 p.

This guide is intended to implement both field and laboratory identification of western Atlantic snappers (Lutjanidae). Eight genera and 27 species, of which 7 are of doubtful validity, are considered. Illustrated keys are supplemented by tables that give the ranges of numbers of fin rays, lateral line scales, and gill rakers. (Auth.)

9152. Pflieger, William L. 1966. A CHECK-LIST OF THE FISHES OF MISSOURI, WITH KEYS FOR IDENTIFICATION. Missouri Dept. of Conservation D-J Series No. 3. 63 p.

9153. Marr, D.H.A. 1966. INFLUENCE OF TEMPERATURE ON THE EFFICIENCY OF GROWTH OF SALMONID EMBRYOS. Nature, 212(5065): 957-959.

9154. Tibbo, S.N., and W.B. Scott. 1965. CANADIAN ATLANTIC SHARKS. Fish. Res. Bd. Canada Biol. Sta., St. Andrews, N.B., Canada, General Series Circular No. 47. 4 p.

9155. Seibert, Henri C. (Dept. of Zoology, Ohio Univ., Athens, Ohio). 1966. THE CAUSE OF FISH KILLS IN THE HOCKING RIVER. Ohio Fish Monographs, No. 1. 25 p.

The factors responsible for periodic fish kills in the Hocking River, Ohio, were studied during the summers of 1957 and 1958. Acid water from tributary streams was ascribed as the cause, and the main source of this acid was located at certain points along the Sunday Creek watershed. Rainfall, especially after a dry period, washed accumulated concentrations of acid from around the base of waste coal piles and effected an excessive acid load that was dumped into the Hocking River. Credence in these observations was reinforced by simulating the effects of a rainfall with water released from Burr Oak Reservoir into Sunday Creek. This experiment resulted in a minor fish kill. (Auth.)

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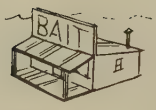

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